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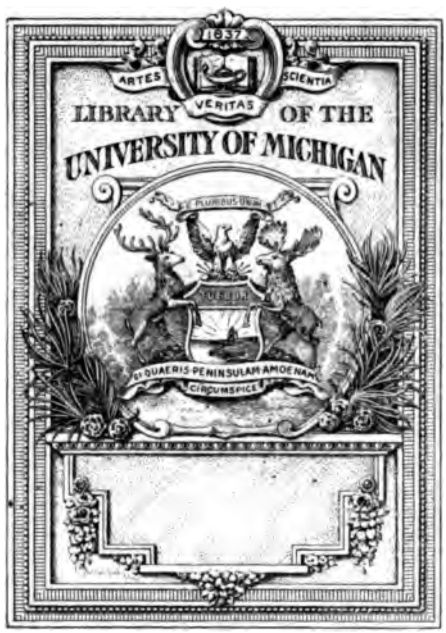
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PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY

HELD AT PHILADELPHIA

FOR

PROMOTING USEFUL KNOWLEDGE

Vol. IX

JANUARY 1862 TO DECEMBER 1864

1862 - 1864

PHILADELPHIA:
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1865.

Complete

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY.

Vol. IX.	JANUARY, 1862.	No. 67.

Stated Meeting, January 3, 1862.

Present, eleven members.

Dr. Franklin Bache, in the Chair.

The judges and clerks of the annual election, held this day, reported the appointment of the following officers:

President.

George B. Wood, M.D.

Vice-Presidents.

John C. Cresson,
Isaac Lea,
George Sharswood.

Secretaries.

Charles B. Trego,
E. Otis Kendall,
John L. Le Conte, M.D.,
J. Peter Lesley.

Counsellors for Three Years.

Isaac Hays,
Robert E. Rogers, M.D.,
Henry C. Carey,
Robert Bridges.

Curators.

Franklin Peale,
Elias Durand,
Joseph Carson, M.D.

Treasurer.

Charles B. Trego.

Letters acknowledging the receipt of publications, were received from the R. Saxon Society, dated Leipsig, August 1, the Royal Society, dated London, July 1, and the London Linnean Society, dated July 14th, 1861.

Letters announcing donations to the Society were read from the Imperial Society of Naturalists, dated Moscow, June 1–13, the Imperial Academy at Vienna, dated June 25, the R. Saxon Society at Leipsig, dated July 9, and 30, the Society at Görlitz, dated July 30, the Society at Göttingen, dated July 19, and the Society at Marburg, dated August 14, 1861, desiring an exchange of publications. The Marburg Society was ordered to be placed on the list of correspondents, to receive the Proceedings.

A letter was read from the Directors of the U. S. Naval Observatory at Washington, which Institution was ordered to be placed on the list of correspondents, to receive as full a series of the Transactions as can be made up.

Donations for the Library were received from the Academies and Societies at St. Petersburg, Moscow, Vienna, Leipsig, Görlitz, Marburg, Göttingen, Haarlem, and Dijon; the School of Mines at Paris; the Royal and Linnean Societies of London; Prof. Secchi, of Rome; the Director of the U. S. Observatory at Washington; the Director of the U. S. Mint at Philadelphia; C. M. Wheatley, of Phœnixville; Charles Ellet, Jr., and Joseph Lesley, of Philadelphia.

Mr. Peale called the attention of the Society to the resumé of recent Antiquarian Science of Prof. Morlot, of Geneva, published by the Smithsonian Institution; and exhibited a specimen, from his own cabinet, of a saw-like stone, resem-

bling the implements with crenulated edges described as saws by Prof. Morlot.

Prof. Lesley presented three short original Vocabularies of African Dialects, obtained by Rev. Alexander Crummell, from among four hundred recaptured slaves, landed from a United States war vessel at Sino, in Liberia.

The following words were obtained by the Rev. Mr. Crummell, from a crowd of recaptured Africans, landed at Sino, in Liberia, about two hundred miles west of Cape Pálmas. The slaves were about four hundred in number, and apparently of four or five distinct nationalities, each group conversing and keeping apart. Mr. Crummell had the aid of several intelligent interpreters whom he found among them, and took great pains to secure both the true words and the correct pronunciation. As the English language is gradually supplanting the native African dialects along that coast, every authentic addition to our collections becomes valuable. In re-writing these words I have employed the continental vowels. The v is a pure English v, and the consonants are written double only when clearly pronounced double. The most striking feature of these little vocabularies, is the application of almost the same dental dissyllable to a number of very dissimilar objects. I refer to the words Ade (1), Ato (3), Ane (4), Ede (6), Añe (8), Ionu (woman), Addo (stomach), Adu (teeth), Ade (tongue), Edda (hair), Etta (head), Etto (ear), Ido (eye). I suspected that some error had been occasioned by the use of pantomimic references to the members of the head, and that thereby the word for *head* was offered, when words for eye, ear, hair, tongue, teeth, &c., were required. But Mr. Crummell assured me that this source of error was carefully guarded against. We find the analogues of this dental dissyllable in the list of words meaning *head*, published in Vol. VII, page 151 of the Proceedings of this Society, among the Indian languages of America, in e. x. the Naguiler *Φie*, the Chippewayan *edΦie;* among the European languages, in the French *tête*, the Wallzau *totao*, the Caucasian *dudi* and *adada*, the Siberian *ty*, Chinese *teu*, and Manchu *udzu*. We find the same form meaning *hair* in the Vogul and Samoied words *otta*, *yta*, *yt*, *at*, *aeti*, and *tue*. It is remarkable how rarely this simple dental form occurs in that list; and that the confounding of *head* and *hair* under this form occurs in the same region.

	Popo and Jelakufi People.	Awūsa People.	Dahomi.
1.	Uli,	Ade,	Dok-po.
2.	Biu,	Erver,	Oʿ-we.
3.	Oku,	Urtong,	A-to.
4.	Hodu,	Ane,	Eʿne.
5.	Biat,	Etong,	A-tong.
6.	Sid-da,	Ede,	Ai-ise.
7.	Bok-koi,	De-din-ne,	Teg-we.
8.	Tok-quos,	Añe,	Taʿ-to.
9.	Tera,	'Shaki,	Teʿ-ne.
10.	Go-mer,*	Eŏ,	Oʿ-o.
Sun.	Allar,	Don-kus-so, Er-we,	Weʿ-di-ve.
Moon.	Wa-ta,	U-la-ti,	Oʿ-su.
Man.	Bar-bar,	Er-wu-su,	Su-nu.
Woman.	Mut-chi,	En-nun-nu,	Io-nu.
Hand.	Han-nu,	Al-lo,	Al-lo-pa.
Foot.	Koppa,	Af-fo,	Af-fo.
Face.	Fis-ca,	Eʿ-u-ma,	An-nu-ku-mi.
Stomach.	Chik-i,	Ad-do,	Ad-do-go.
Arm.	Dŭm-si,	Ab-lo,	Aʿ-waʿ.
Teeth.	Hai-ko-li,	Ad-u,	Ad-u.
Tongue.	Hal-lis-si,	Ad-e,	Ad-e.
Hair.	Gai-si,	Ed-da,	U-da.
Head.	Kai-si,	Et-ta,	U-ta.
Nose.	Han-si,	Em-mo-ti,	Aʿ-wo-ti.
Ear.	Quin-ni,	Et-to,	Et-to.
Eye.	Id-o,	En-ku-ve,	Un-de.

Prof. Haldeman described certain peculiar words and sounds of the Basque language, obtained from natives, on his late visit to Europe.

The attention of the members present was invited to a set of lithographs of fossil sauroid bones, discovered by Mr. C. M. Wheatley, in the Phœnixville Tunnel, on the Schuylkill River, about thirty miles above Philadelphia, in rocks of the New Red Sandstone Formation. The originals form part of

* Basque, 'amar.

Mr. Wheatley's extensive cabinet of undescribed Mesozoic plants, shells and bones.

On motion of Mr. Fraley, Mr. Lesley was nominated Librarian for the ensuing year.

Pending nominations Nos. 425 to 445, and new nomination No. 446, were read.

And the Society was adjourned.

Stated Meeting, January 17, 1862.

Present, twelve members.

Dr. FRANKLIN BACHE, in the Chair.

The Verein für Naturkunde im Herzogthum Nassau, was ordered to be placed upon the list of corresponding societies.

Donations for the Library were received from the Academy at Boston; the Massachusetts Board of Agriculture; the Medical Journal and Franklin Institute; B. V. Marsh, and Sherman & Son, of Philadelphia.

Dr. Bache announced the death of Sir John Forbes, a member of this Society, November 13, 1861, aged 74.

Prof. Lesley, read extracts from letters from Prof. James Hall, of Albany, relative to the Taconic System of Dr. Emmons.

The discussion of this system has lately been revived by Mr. Marcou, supported by the distinguished Bohemian palæontologist M. Barrande. Mr. Hall in these letters claims that the original error was made by the geologists of the New York Survey, who had charge of the eastern divisions of the State, in identifying the two slate formations on the two opposite sides of the Hudson River. Sir William Logan, chief of the Canada Survey, describes a similar error made in the great plain of the Richelieu River, before the existence of the great fault in Canada was known. Mr. Hall, accepting the identification in the Hudson region, proved long ago that the Hudson River slates were the same as the Taconic slates of Emmons. It now appears, that the Hudson River slates, east of the Hudson, are not the No. 3 (the upper part of the Lower Silurian) slates of New Jersey and Pennsylvania, west of the Hudson; and that that name must be dropped; or applied only to the slates of the Hudson River

Valley proper, at the base of the Lower Silurian Formation. In like manner, the Canadian geologists, having traced the great fault from Cape Gaspé, for seven hundred miles, along the south shore of the Lower St. Lawrence, past Quebec, across the plain of the Richelieu, and along the east shore of Lake Champlain, to meet the Hudson River Valley fault, which seems to terminate north of the Highlands, it is now certain that the Quebec Group, the Georgia rocks of Vermont, and the whole Taconic System of Dr. Emmons, belong to the Lower Silurian System near its base, and are a thickening eastward of the calciferous sand-rock over the Potsdam Sandstone which lies at its base. As soon as fossils were discovered in the slates on the east side of the great fault, those slates had to be referred to the base, instead of to the top of the Lower Silurian. But no further change was needful. Everything else remained the same. The structure of the Taconic range, and of the Canadian plain, remained the same. Dr. Emmons's Taconic System *beneath the Potsdam sandstone* has no existence now, any more than it had before the discovery of the fossils, and their recognition by Barrande. Professor Hunt, of Montreal, has shown how both M. Marcou and M. Barrande have mistaken Dr. Emmons's language, where he speaks of an "inversion" of the series in the Taconic Mountains, east of the Hudson. Dr. Emmons supposed the existence of not one great fault, but numerous parallel faults, bringing up lower and lower sandstones, slates and marbles, as one crosses them going east. His interpreters ignorantly suppose a fan-shaped structure in the Green and Berkshire Mountains, *overturning* the dips in the ranges to the west of them. Dr. Emmons taught an *apparent* inversion produced by the parallel upthrows. His interpreters teach an *actual* inversion by overthrow. The succession of the strata, however, is equally falsified by the view of Dr. Emmons and by that taken by his interpreters. Dr. Emmons, however, argued correctly from his premises. Did the parallel and increasing upthrows exist, then the Taconic System would be as he says it is, beneath the base of the Lower Silurian System. M. Marcou, on the contrary, misconceives the whole structure, and his conclusion flows just contrariwise from his premises. The recent careful map survey of the minute anticlinal subfolds of the great fault along the east shore of the foot of Lake Champlain, by Sir William Logan, has resulted in establishing the old accepted order of the rocks, as both the apparent and the real order of the Taconic System; and the only resource we have is to accept his theory, of a great thickening of the calciferous sand-rock along a deep

sea-shore line, extending from the mouth of the Gulf of St. Lawrence to Alabama; and a subsequent disruption and up-shove against this steep shore, along perhaps its whole extent, certainly along an extent of seven hundred miles. Along this whole line the once so-called "Hudson River Slates" (the No. 3, of the Pennsylvania Survey) are over-ridden by and abut against the Hudson River Slates proper (Taconic Slates, or No. 1, of the Pennsylvania Survey). Whether the Philadelphia and Baltimore System will obtain hereby, at last, its explanation, we can only conjecture. But certainly its rocks and minerals resemble some of the members of this "Quebec Group" or Taconic System; and there are evidences along its northwest edge, from Trenton past Philadelphia, of a great fault, in the place where we should be inclined to look for one.

Mr. Powel exhibited the stalk of an *Asclepias* from his garden, to show the strength of its fibre. Prof. Haldeman, mentioned an instance of thread spun from the nettle fibre.

Prof. Lesley was chosen Librarian for the ensuing year.

Standing Committees for the year were chosen, as follows:

On Finance.—Mr. Fraley, Mr. J. F. James, Mr. Samuel Powell (in the place of Mr. Justice, declining re-election).

On Publication.—Dr. Bridges, Mr. T. P. James, Dr. Hartshorne, Prof. Coppée, Dr. Wister.

On the Hall.—Mr. Peale, Judge King, Prof. Coppée.

On the Library.—Dr. Bell, Dr. Stevens, Dr. Coates, Mr. Foulke, Mr. Barnes (in the place of Mr. Ord, declining re-election).

The list of surviving members was then read, as follows:

Summary.

On the List, January 1, 1861,			376
Elected in 1861,	In the U. S.	4	8
	Foreign	4	384
Reported as deceased,	In the U. S.	6	9
	Foreign	3	375
Resigned, in the U. S.			1
Number of members January 1, 1862,			374
Of whom are resident in the U. S.		267	
And in foreign countries		107	

Nominations Nos. 425 to 446, and new nomination No. 447, were read.

Nominations Nos. 425 to 445 were ballotted for.

The report of the Committee on the Library was presented, and its consideration postponed, owing to the lateness of the hour.

The ballot boxes being opened, the following persons were declared by the presiding officer duly elected members:

Mirza Alexander Kasem Beg, of St. Petersburg.

Professor Otto Böhtlingk, of St. Petersburg.

Professor G. Forchhammer, of Copenhagen.

Professor J. S. Steenstrup, of Copenhagen.

Professor C. J. Thomsen, Director of the Royal Museum at Copenhagen.

Professor Andrew C. Ramsay, of England.

Professor Edouard Desor, of Neuchâtel.

Professor L. G. De Koninck, of Liége.

Professor Joachim Barrande, of Prague.

Professor Robert W. Bunsen, of Heidelberg.

Professor William Hoffman, of London.

Doctor H. R. Göppert, of Breslau.

Professor Alexander Braun, of Leipsig.

Mr. William J. Hamilton, of London.

Sir William J. Hooker, of London.

Doctor J. J. Kaup, of Darmstadt.

Doctor J. Anthony Froude, of Oxford.

Doctor Hermann Lebert, of Breslau.

Doctor S. Weir Mitchell, of Philadelphia.

And the Society was adjourned.

Stated Meeting, February 7, 1862.

Present, eleven members.

Vice-President, Judge Sharswood, in the Chair.

A letter, accepting membership, was received from Dr. S. W. Mitchell, dated 1226 Walnut Street, January 31, 1862.

Letters were read from Mr. B. Whiting, senior officer, and Mr. Hubbard, Librarian of the Washington Observatory, dated January 21, 1862, acknowledging the receipt of publications.

A letter was received from M. Paul Bossange, dated New York, January 30, 1862, respecting the Annales de Chimie et de Physique.

Donations for the Library were announced from the Library Company of Cape Town, South Africa; the Bureau of Engineers at Paris; the R. Astronomical Society, the American Academy, American Antiquarian Society, and Boston Society of Natural History; Prof. H. A. Newton, of Yale College; the Publishers of Silliman's Journal; M. Carey Lea, of Philadelphia, and the Academy of Natural Sciences; the Adjutant General of the United States, and Col. Long, of the Bureau of Topographical Engineers at Washington; and the American Colonization Society.

Pending nominations Nos. 446, 447 were read.

The Committee on the Library submitted the accompanying special report of the Librarian, and recommended its suggestions to the favorable consideration of the Society.

The Librarian reports: That there have been added to the Library by donation in the year 1861, 317 books and pamphlets, and Proceedings of Corresponding Societies. The London, Edinburgh and Dublin Philosophical Magazine, and the Astronomische Nachrichten have been regularly received on subscription.

A large number of pamphlets, periodicals, and publications of societies remain unbound upon the shelves; fifty volumes of pamphlets have been disposed ready for binding, and 150 more volumes will be so disposed during the printing of the Catalogue. . . . . The printing of the Catalogue has proceeded slowly, but steadily. . . . . Two bound copies of the part already printed, are herewith presented, comprising Classes I and II, to page 212; exhibiting the books and pamphlets of a general nature, such as Encyclopedias, Scientific Magazines, the Publications of Societies, and the Catalogues of Libraries; together with books and pamphlets on the Mathematical

Sciences and Physics, including Astronomy, Meteorology, Navigation, Geodosy, Civil Engineering, Geography, Maps and Charts, and Voyages and Travels. The III Class of books and pamphlets on Chemistry, Mineralogy, Mining, Metallurgy, Geology, and Palæontology, carrying the Catalogue folio up to page 250, is in press. These three, with the IV Class, of 130 pages, and the V Class, of 115 pages, would make a volume of about 500 pages, which might be issued as a first volume. Leaving Classes VI, VII, and VIII, to make a second volume of about 600 pages. . . . . The Catalogue has been increased in size to these unforeseen dimensions by the introduction of over ten thousand pamphlet titles, which are usually in themselves longer than book titles, and are still further lengthened by their references. . . . . When the Catalogue is published, an increased use of the Library will probably be a consequence, for which additional room will be needed.

On motion, it was resolved that Dr. Bridges, Dr. Coates, and Dr. Le Conte, be a special committee to obtain information respecting the completion of the Catalogue of the Library.

On motion of Mr. Fraley, an appropriation of $349 35 was made, to pay the bill presented for printing the Catalogue, accompanying the Committee's Report.

And the Society was adjourned.

Stated Meeting, February 21, 1862.

Present, twenty members.

Judge Sharswood, Vice-President, in the Chair.

Dr. S. Weir Mitchell, a newly elected member, was introduced.

Pending nominations Nos. 446 and 447, and new nominations Nos. 448 to 452 were read.

The special committee appointed at the last meeting reported; the report was accepted and the committee discharged. The subject of printing the Catalogue was then discussed,

and on motion of Judge King, was referred back to the committee, with instructions to report at a future meeting of the Society, whether any change can be made in the style of the work, which will diminish the cost of printing the remainder.

On motion of Judge King, the Secretary was directed to communicate with the gentlemen charged with preparing notices of late members, Dr. Robert Hare, Dr. Elisha K. Kane, and the Honorable John K. Kane, and to respectfully request them to complete the same at their earliest convenience.

And the Society was adjourned.

Stated Meeting, March 7, 1862.

Present, fifteen members.

Judge SHARSWOOD, Vice-President, in the Chair.

A letter was read from Sir Roderick I. Murchison, dated London, February 18, 1862, accepting membership.

A letter was received from Samuel Hazard, Librarian of the Historical Society of Pennsylvania, dated Philadelphia, February 25, acknowledging the receipt of the Proceedings.

A letter was received from S. H. Long, Col. T. E., accompanying a donation for the Library.

Pending nominations Nos. 446 to 452 were read.

New nominations Nos. 453, 454, 455 were read.

Dr. Bache announced the death of F. Martinez de la Rosa, a member of this Society, aged 73, who died in 1862.

Dr. Coates asked to be excused from preparing an obituary notice of Major John Le Conte, which on motion was granted, and Dr. Torrey was appointed in his stead.

Mr. Durand asked and received permission to borrow the MS. Journal of M. André Michaux, for the purpose of making extracts therefrom.

Mr. Tilghman offered the following:

Resolved, That a committee be appointed to report to the Society the names of any of its members, who may have been

publicly and notoriously engaged in acts of treason against the United States, and to inquire into the expediency of striking their names from the list of its members; which after debate was postponed for the present.

And the Society was adjourned.

Stated Meeting, March 21, 1862.

Present, twenty-seven members.

Judge SHARSWOOD, Vice-President, in the Chair.

Letters were read from the Central Physical Observatory, of Russia, acknowledging and transmitting publications, dated St. Petersburg, June and July, 1861; from the Royal Bavarian Academy, dated Munich, Dec. 2, 1861, accompanying a donation to the Library; and from Mr. J. D. Serjeant, Librarian of the Academy of Natural Sciences, Philadelphia, dated March 14, offering for sale certain copies of parts of the Transactions of this Society; which was referred to the Committee on the Library.

Donations to the Library were presented from the Central Observatory of Russia; the Academy at Munich; the Boston N. H. Society; the Franklin Institute; the Royal Astronomical Society, London; the Dublin University Association; the State Library at Harrisburg; the Philadelphia Gas Works; Silliman's Journal; G. P. Putnam, of New York; Charles Nagy, of Hungary; and J. S. Newberry, of Washington.

Dr. Coates made a verbal communication respecting the Catalogue raisonnée of the Medical Library of the Pennsylvania Hospital, at Philadelphia.

Pending nominations Nos. 446 to 455 were read.

Mr. Tilghman offered the following resolution, in lieu of the one offered by him at the last meeting: "Whereas, Matthew F. Maury and W. F. Lynch have committed public and notorious acts of treason against the United States, it is

hereby ordered that they be expelled from this Society,"—which, with Mr. Gerhard's amendment, "And whereas, they have withdrawn themselves from the service of notice upon them by this Society," was agreed to; the ayes and nays being called, there were 23 ayes, 3 nays, and one excused from voting.

And the Society was adjourned.

Stated Meeting, April 4, 1862.

Present, nineteen members.

Judge SHARSWOOD, Vice-President, in the Chair.

A letter was read from the Royal Danish Society, dated Copenhagen, July 1, 1861, acknowledging the receipt of publications.

Letters, acccompanying donations, were received from the Royal Society of Upsala; the Royal Danish Society, dated Copenhagen, July 1; the Royal Prussian Academy, dated Berlin, August 31; the Prince Jablonow'ski Society, dated Leipsig, November 20; the I. Academy, dated Vienna, October 28; the Dublin University Assocation, dated November, 1861; and Dr. Dunglison, dated Philadelphia, February 19, 1862.

Judge King moved that the MSS. presented by Dr. Dunglison be referred to a special committee, consisting of Judge King, Judge Sharswood, and Mr. Price.

Donations to the Library were received from the Academies at St. Petersburg, Berlin, Munich, Vienna, Turin, and Paris; the Societies at Upsala, Copenhagen, Leipsig, Emden, and Liverpool; the Royal Astronomical Society at London, and the Geographical Society at Paris; the Horticultural Society at Berlin; the Observatory at Pulkova; the Institutes at Salem, Massachusetts, and Buffalo, New York; the Hospitals at Boston and Harrisburg; from Franz Odernheimer, of Wiesbaden; C. M. Wetherill, of Indianapolis; and Miss Gareschè, of Philadelphia; and from B. L. Emerson, Francis

Leopoldt, John Penington, and Blanchard & Lea, booksellers.

Mr. Price offered for publication in the Proceedings, a copy of the Opinion of the Supreme Court in the suit for taxes against the Society, with a brief communication introductory, as follows:

To the American Philosophical Society:

I have the satisfaction to report to the Society, that the suit of the City of Philadelphia against this Corporation, claiming to tax the Hall, has been decided in favor of the Society, and against the power of the City to tax this property. The Argument of Counsel has been printed, and numerous copies of it are in possession of the Society. As the Opinion of Judge Read, which is that of all the Court, is of historical interest, as well as protective of the title and interests of the Society, I cannot but recommend that it be printed in the Society's Proceedings. For this purpose I herewith furnish a copy of that Opinion. I am, very respectfully, &c,

Eli K. Price.

SUPREME COURT. THE CITY OF PHILADELPHIA v. THE AMERICAN PHILOSOPHICAL SOCIETY.

The Hall of the American Philosophical Society is not liable to taxation.

Eastern District. Error to the District Court of Philadelphia. Opinion by

Read, J.—Independence Square was not one of the original squares left open for public use by William Penn in his platform of the City of Philadelphia, but consisted of various lots purchased at different times under the authority of the Legislature of the Province. The intention was to erect a State-house and other public buildings upon it, and that the residue of the square should be and remain a public green and walk forever. The old court house had been built in 1707, in Market Street above Second, and was used not only as a hall of justice, but also as a legislative hall, in which the Provincial Assemblies transacted their business, and the general elections were held there. By the direction of the Representatives of the Freemen of the Province, Andrew Hamilton and William Allen purchased certain lots on the south side of Chestnut Street, lying contiguous to each other, and bounded by Delaware Fifth and Sixth Streets, and erected thereon the present State-house, which was begun

in 1729 and finished in 1734. On the 20th February, 1735–6, the General Assembly passed an Act vesting the State-house and other public buildings, and the lots, in other trustees, to and for the use of the Representatives of the Freemen of the Province, and to and for such other uses as the said Representatives at any time or times thereafter in General Assembly met, should direct and appoint. "Provided *always*, and it is hereby declared to be the true intent and meaning of these presents, that no part of the said grounds lying to the southward of the said State-house, as it is now built, be converted into or made use of for erecting any sort of buildings thereon, but that the said ground shall be inclosed and remain a public open ground and walk forever." Another contiguous lot having been purchased by William Allen, and both he and Andrew Hamilton having died without executing the necessary assurances, the General Assembly, on the 17th January, 1762, passed an Act vesting the whole property in new trustees, for the same uses declared in the former Act, and under the same proviso, with an immaterial alteration in its phraseology, and on the 14th May in the same year, they passed another Act, authorizing the trustees to purchase the remaining lots between Chestnut and Walnut Streets, for the same uses, and appropriated five thousand pounds for that purpose. By the first of these Acts, two lots, one at the corner of Sixth, and the other at the corner of Fifth Street, were directed to be conveyed, upon the payment of fifty pounds for each, the first to trustees for the use of the County of Philadelphia, for erecting a public building for the holding of courts or common halls for the said county; and the second to the Mayor and Commonalty of the City of Philadelphia, for erecting a public building thereon for the holding of courts or common halls for the use of the said city.

On the 28th February, 1780, the General Assembly of the Commonwealth vested the State-house, and the whole lot between Walnut and Chestnut and Fifth and Sixth Streets, in the Commonwealth, to the uses and trusts theretofore appointed and limited. The legal title was therefore in the State of Pennsylvania. From a club called the Junto, originated in 1727, by Benjamin Franklin, sprung a proposition to form a society composed of *virtuosi* or ingenious men residing in the several colonies, to be called The American Philosophical Society, to be held at Philadelphia, being the city nearest to the centre of the continent colonies, communicating with all of them northward and southward by post, and with all the islands by sea, and having the advantage of a good growing library. It was made in the form

of a circular, signed by Franklin, which bore date the 14th of May, 1743, old style, corresponding in the new calendar to the 25th, which is considered as the birthday of the present institution. In 1744, the Society, so far as relates to Philadelphia, was actually formed, and had several meetings, to mutual satisfaction, of the nine original members of the Philosophical Society. Six, including the three officers, President Hopkinson, Treasurer Coleman, and Secretary Franklin, are known to have belonged to the Junto.

Out of another Junto, established in 1750, arose another body in 1756, called "The American Society for Promoting and Propagating Useful Knowledge," held at Philadelphia; and in November, 1768, the name being changed to The American Society held at Philadelphia for Promoting Useful Knowledge, Dr. Benjamin Franklin was elected its President. The first institution, The American Philosophical Society, was also revived about the same time, and on the 9th February, 1768, ex-Governor Hamilton was elected President of this body.

On the 2d January, 1769, these two institutions having merged themselves into one body, being the present "American Philosophical Society, held at Philadelphia, for Promoting Useful Knowledge," Dr. Benjamin Franklin was elected President, and Dr. Thomas Cadwalader, Dr. Thomas Bond, and Joseph Galloway, Esq., were elected Vice-Presidents. The Society, aided by the General Assembly of the Province, erected temporary observatories, one at Philadelphia, the other at the residence of Mr. Rittenhouse, in Newton township, Montgomery County, about twenty miles northwest of Philadelphia, for observing the expected transit of Venus, that was to occur on the 3d of June, 1769.

Measures were also taken for making observations at Cape Henlopen, on the Delaware Bay, where a building was found that could be used for the purpose. The observations at these different places were all successful, and the account of them, and of the results to which they led, is given in full detail in the first volume of their Transactions, published in 1771, from the press of William & Thomas Bradford, in this city.

Upon their application, the General Assembly, on the 15th March, 1780, passed an Act incorporating them, and one of its provisions, as indicative of the liberal policy, humane spirit, and wise forethought of our forefathers in the midst of a war for existence, is too remarkable to be omitted. That it shall be lawful for the "Society, by their proper officers, at all times, whether in peace or war, to

correspond with learned societies as well as individual learned men of any nation or country, upon matters merely belonging to the business of the Society, such as the mutual communication of their discoveries and proceedings in philosophy and science, the procuring books, apparatus, natural curiosities, and such other articles and intelligence as are usually exchanged between learned bodies for furthering their common pursuits." This learned Society has always preserved its high character both at home and abroad, and numbers among its members the most distinguished men of the day. Of the past it enumerates among its Presidents, Benjamin Franklin, Thomas Jefferson, Rittenhouse, Wistar, Patterson, Tilghman, Duponceau.

On the 15th April, 1782, the General Assembly transferred the property and moneys of the Silk Society to the Philosophical Society, who were to be accountable, and redeliver the same whenever a majority of the subscribers to the Silk Society shall request it, in order to revive their institution. The Philosophical Society having represented to the Legislature the necessity of their having a Public Hall, Library, and other accommodation, and prayed that they would grant to them a lot of ground suitable and convenient for erecting a hall and other buildings, an Act was passed on the 28th March, 1785, granting to them a lot on Fifth Street, being a part of the State-house square, for that purpose. The third section is in these words: "Provided always, and it is the intention and meaning of this Act, that the said lot of ground shall not *be sold, leased or transferred*, by the said Philosophical Society or their successors, to any other person or persons, or bodies corporate; nor shall the same be applied by the said Society to any other use or purpose but that of erecting buildings for the accommodation of the said Society, as hereinbefore specified." Upon a further representation from the Society, that the restriction in the preceding Act as to the letting parts of the building was disadvantageous and unreasonable, the House thought it was founded in reason, and on the 17th March, 1786, passed an Act authorizing the Society to let or lease such *vaults* or *cellars* as they may think proper to make under the building by them to be erected on the lot aforesaid, and to let any other parts of said building for such purposes as may have affinity with the design of their institution, and for no other; the issues and profits to be applied to the purposes for which the Society was originally instituted, and to no other.

By the Act of the 8th April, 1785, the Commissioners of the County of Philadelphia, and the Wardens of the City of Philadelphia, having respectively paid to the Treasurer of the State the sum of

fifty pounds each, the lots at the corners of Sixth and Fifth Streets were severally vested in the said parties respectively, agreeably to the Act of 1762. The Act also provided that the old gaol and workhouse should be sold, and three thousand pounds of the purchase-money be applied to the purpose of erecting the County Court-house on the northwest corner of the State-house lot; and the wardens were authorized to take out of the personal estate of the latter corporation, three thousand pounds for erecting a court-house on the northeastern corner of the said State-house lot, and if it fall short of completing the building, then such sums as shall be necessary shall be taken out of the common stock of the city in the hands of the Treasurer of the Wardens. These lots were extended in depth to 88 feet by the Act of 29th March, 1787; and by the Acts of 27th March and 29th September, 1789, a lottery was authorized to raise eight thousand dollars to defray the expenses of erecting a common hall in the city of Philadelphia. On the 11th March, 1789, the City of Philadelphia was incorporated by an Act of the General Assembly, by the name of "The Mayor, Aldermen, and Citizens of Philadelphia," its limits being the original city plot of William Penn, as delineated in Holmes's Portraiture of it: two miles in length, from river to river, and one mile in breadth, from Vine to South Street.

By an Act of the 30th September, 1791, the Governor was authorized to contract for paving the footway round the State-house square at such times as the City Commissioners shall be paving the cartways of the several streets which surround the State-house. The same Act, after reciting that it would contribute to the embellishment of the public walks in the State-house garden, and may conduce to the health of the citizens by admitting a free circulation of air, if the east and west walls of the said garden were lowered, and palisadoes placed thereon, authorized the city corporation, at their expense, to take down the wall on the east and west sides of the State-house yard, within three feet of the pavement, and to erect thereon good and substantial palisadoes of iron, fixed on a stone capping, to be placed on such wall so prepared.

The City Hall was occupied by the executive, legislative, and judicial authorities of the city; whilst the Congress of the United States, on their removal from New York to Philadelphia, in 1790, occupied the County Court-house, the use of which was offered to them by the Commissioners of the City and County of Philadelphia, for their accommodation during their residence in Philadelphia, until their final removal to Washington, in 1800. The State-house had

been used by the General Assembly of the Province and State for their place of meeting from 1735 until the removal of the seat of Government to Lancaster, in November, 1799. The Congress of the Confederation had also used it during the Revolutionary war, and continued its occupation until the 24th of December, 1784, when they adjourned to meet in the city of New York. The east room on the first floor of this building was the scene of the Declaration of Independence, on the 4th July, 1776.

By a resolution of the General Assembly of the 17th March, 1802, Charles Wilson Peale was allowed to remove his Museum into the east end of the State-house, and to use the lower story of the east end, except the room formerly occupied by the Legislature as a committee-room, and the whole of the upper story, as he might find most convenient for the arranging and displaying the said museum, during the pleasure of the Legislature; but it was provided that the citizens should hold their general elections at the State-house according to law, and he was to take charge of the State-house and State-house yard, to open the doors of the hall, and permit the citizens to walk in the yard for recreation, and pass and repass at reasonable hours. Under this *regime* I have often visited the museum, which was a favorite place of resort, and as a boy, played marbles and prison-base in the State-house yard, whilst it was still surrounded by the high brick wall. On the 8th August, 1811, an ordinance was passed to carry out the permission to take down the east and west walls of the State-house yard, and erect iron palisadoes in place thereof, granted by the Act of 1791; and on the 10th March, 1812, the Legislature passed another Act, empowering the Select and Common Councils to take down the south wall and make a similar improvement, and giving them the charge of the yard, and repealing so much of the resolution of 1802 as gave Mr. Peale the charge and care of it; and on the 23d April, in that same year (1812), an ordinance was passed to carry the Act into effect, and the City Commissioners were directed to take charge of the State-house yard, and keep it in proper order.

On the 24th March, 1812, the Legislature authorized the County Commissioners to occupy the east and west wings of the State-house for the accommodation of the public offices of the city and county, and to convert the same into fire-proof buildings, or, if found most convenient, to rebuild the same upon a more extended plan; which law was adopted; and a fire-proof, and one other suitable portion of said building was appropriated exclusively to the safe-keeping of the records of the office of the Prothonotary of this court, and for his

use; but it was provided that the title in fee simple to the lot on which said offices may stand, be reserved to the Commonwealth.

By an Act of 13th March, 1815, the Legislature authorized the County Commissioners to take charge of the State-house, and to let the rooms, giving a preference of the upper part to Mr. Peale, but no lease to exceed one year, and repealed so much of the resolution of 1802 as made it the duty of Mr. Peale to take charge of the State-house; and after the sale to the city on the 23d March, 1818, they directed the Commissioners to give up possession of the lower part to the city.

On the 11th March, 1816, the Legislature passed a very disgracious Act, providing for the sale of the State-house and State-house yard, by running a street or streets through it, laying it out in lots, and valuing them so as to produce $150,000, and ordering the removal of the clock to Harrisburg; giving, however, an option before a specified period, to the city corporation to purchase the whole for $70,000 (with certain exceptions), but expressly declaring that in such case "no part of the said ground lying to the southward of the State-house, within the wall as it is now built, be made use of for erecting any sort of buildings thereon, but the same shall be and remain a public green and walk forever."

The two lots reserved and excepted out of the State-house square, were the County Court-house lot, and the lot on the northeast corner, reserved for the use of the city, and the lot on the east side of the square, granted to the American Philosophical Society under the Act of the 28th March, 1785, "and the two public offices which, by the Act of March 24, 1812, were put into the possession of the Commissioners of Philadelphia County, which said offices are thereby released from the claim of the State, and given and granted in fee simple, in lieu of the expense laid out in repairs on the State-house yard; and the offices and ground on which they stand, or on which they are allowed by the said Act to stand, are thereby granted and confirmed to the said City and County of Philadelphia forever."

By the Consolidation Act, the whole of this entire square, with all the buildings on it, with the exception of the lot of the American Philosophical Society, is vested in the City of Philadelphia, subject, of course, to the public use re-declared by the Act of 1816, as to all the ground lying south of the State-house.

By an Act of 16th March, 1847, the County Commissioners and the Select and Common Councils,—whose powers are now all merged in the consolidated city,—were severally authorized to erect a new

court-house and a new city hall on parts of the State-house square; but the authority thus given has never been exercised, and the Act of the 2d April, 1860, was never carried into effect; a fortunate circumstance in the present state of our finances.

It will be perceived by this statement, and their present occupation, that all the buildings belonging to the city on the State-house square, are devoted entirely to public purposes—to the courts of justice—including the Supreme Court, who are expressly provided for in the Consolidation Act, and to all the public offices of the county, and of the city, into which they are practically merged, and by whose authority they are provided with a local habitation.

The State, bearing in mind the services rendered to science by this Society, and at the same time determined that this lot should never be held by private owners, nor devoted to any but public uses connected with the welfare of her commercial metropolis, on the 11th February, 1842, authorized the Society to sell or lease their lot, and to make legal conveyance of the same, so that the same shall be used for the accommodation of courts of justice, and offices connected therewith, or for the public use of the City or County of Philadelphia. Under this restriction it is clear there can be only two purchasers or lessees,—the United States and the City of Philadelphia; and it is equally certain that the latter should be its owner. The proceeds of sale can only be applied to the purchase of convenient ground and buildings for the accommodation of the Society, and the residue for the furtherance of the objects for which the Society was instituted. By the second section of the Act of 13th March, 1847, the Society were further authorized to lease such portions of their buildings as may not be required for their immediate use, for such rents and in such manner as they may deem expedient; such rents to be used by them solely for promoting the objects for which they were incorporated.

On the 25th April, 1857, the Legislature gave their consent to the United States purchasing the lot and buildings in pursuance of the Act of 1842: the United States to hold the same for the purposes and business of courts of justice, and the offices and officers connected therewith. The vaults and cellars were allowed to be rented like those under the City Hall, and under many of our churches, for the storage of goods and groceries; the rooms in the lower parts were often lawyers' offices. At one time, the Athenæum was located there; and now, we believe, they are occupied solely by the United States: the issues and profits have always been applied to the fur-

therance of the scientific objects of the Society. The number of scientific men is always small, in any community, their means are generally limited, and their pursuits are of a character not to enlist the sympathies or enthusiasm of the wealthier classes of society. It would seem impolitic and unwise, therefore, for the State that fostered it, or the city which should be proud of it, to cut off their limited resources by taxation, even if it be legal, which was never dreamed of by anybody until 1853.

The taxes claimed are for city and State from 1853 to 1858, both inclusive, amounting, without interest or costs, to $1203.

All taxes on real estate in the City and County of Philadelphia are declared to be a lien on said real estate; the nature of which real estate is to a certain extent defined by the priority given to them over any recognizance, mortgage, judgment, debt, obligation, or responsibility which such real estate may become charged with or liable to. Now the eventual legal title to the Society lot is in the Commonwealth, whilst the Society have the use of it for what may be called a public purpose, the erection of a hall, library, and other buildings, as may be necessary for their proper accommodation. This is accompanied by a provision which no private individual could impose upon a fee simple estate, to wit,—a perpetual prohibition against alienation. The Society were expressly told that it was the intention and meaning of the Act making the grant, that the said lot of ground shall not be *sold, leased,* or *transferred* by the said Society or their successors, to any other person or persons, or bodies corporate; nor shall the same be applied by the Society to any other use or purpose but that of erecting buildings for the accommodation of the Society, as thereinbefore specified. A more guarded method of preserving this property, the free gift of the State, from being appropriated by any act of the law or of the Society, to any other than its expressed public and patriotic purposes, could not well have been devised. This provision being found to be too severe on the Society, they were permitted by legislative action,—1. To let the vaults or cellars under the building to be erected, and to lease any other part of the building for such purposes as may have affinity with the design of their institution, and for no other; but the issues and profits arising therefrom could only be applied to the purposes for which the Society was originally instituted, *and to no other.* 2. To sell or lease the lot, and make legal conveyance thereof, so as that the same shall be used for the accommodation *of courts of justice and offices connected therewith, or for public uses* of the City or County of

Philadelphia: Provided, however, that the proceeds of any such sale shall be applied to the purchase of convenient ground and buildings for the accommodation of the Society, so far as may be necessary to the furtherance of the objects for which the Society was instituted. 3. They were permitted to lease or let such portions of their building as may not be required for their immediate use; such rents to be used by them *solely for promoting the objects for which the Society was incorporated.*

It is clear, then, that the Society could not charge this lot by any recognizance, mortgage, judgment, debt, obligation, or responsibility, nor could they create any lien upon it; because it could not be sold by any form of execution, and this being the case, no taxes could be a lien upon it, and no form of proceeding to recover the same could create a lien upon this lot, because it could not be sold under any such judgment. It seems stronger in the case of taxes levied under the authority of the very Government that has expressly prohibited any sale of it, except in the cases specially pointed out, and by the character of its public uses as expressly declared. The uses for which it was given are public, and can neither be affected nor destroyed by the adverse action and process of a court of law. The court below were therefore right, and their judgment must be affirmed.

This Society numbers amongst its members many distinguished foreigners of great scientific eminence, and it corresponds with public bodies and private individuals devoted to the pursuit of science in every country in Europe; one of its latest correspondents being a Hungarian Society, whose Transactions are published in their native language. It has a most valuable library of about 27,000 volumes, of which a complete catalogue is now preparing at a very heavy expense, including a great many manuscript letters and papers of a most valuable and rare character, relating to the early history of this province and country. A large number of the works in the library are of a scarce and rare kind, and are not to be found on this side of the Atlantic, including a complete set of the Transactions of the Royal Society of London, commencing two centuries ago. The first President of this Society was the originator of the first fire company, the first public library, the first hospital, and the first academy, now the University of Pennsylvania, a signer of the Declaration of Independence, minister to France, one of our ministers plenipotentiary who signed the provisional articles and the definitive treaty of peace

between the United States and Great Britain, and finally one of the framers of the Constitution of the United States.

This was Dr. Benjamin Franklin, the patriot and the philosopher; and I cannot but express a confident hope that the City and the State of which he was so distinguished an ornament, will never permit the hands of the tax-gatherer to diminish the fund devoted to the interests of science in every part of the world, both in peace and in war, and belonging to a Society of which he was the founder.

Judgment affirmed.

Pending nominations Nos. 446 to 455 were read.

The special committee on the Catalogue presented a report, which on motion of Dr. Bache was adopted and the committee discharged.

On motion of Judge King, it was *Resolved*, That the Society authorize and request its officers to execute a power of attorney, to M. A. Germain, of Pontoise, notary, charged with the execution of the Will of the late M. André Michaux, constituting him the attorney at law and in fact of this Society, to maintain its rights to the legacy bequeathed to it therein; which power of attorney is now present and read before the Society.

Mr. Foulke tendered his resignation from the Library Committee, which was accepted, and Mr. Price was appointed by the Vice-President to supply the vacancy.

And the Society was adjourned.

Stated Meeting, April 18, 1862.

Present thirty-six members.

Dr. FRANKLIN BACHE, in the Chair.

Mr. Sidney George Fisher, a new member, was presented by Mr. Fraley.

Baron Ostensacken and Mr. Kimber, members of Corresponding Societies, were introduced by Dr. Le Conte and Professor Coppée.

Mirza Alexander Casem Beg, a new member, signified his

acceptance of membership by letter, dated St. Petersburg, March 3–15, 1862.

Letters acknowledging the receipt of publications, and requesting the completion of their sets, were received from the Essex Institute, dated Salem, Massachusetts, March 28; from Harvard College, April 7; from the New York State Library, April 5; from the Astor Library, April 5; from the New York Lyceum, April 14; and from the Chicago Historical Society, April 7, 1862.

A letter announcing a large donation for the Library, was received from the Royal Academy of History, dated Madrid, March 12, 1862.

A letter was read from Dr. Wood, the President of the Society, to the Secretary, dated Florence, March 17, 1862.

A letter from Wm. Jones, Librarian of the Buffalo Young Men's Association, was read and referred to the Library Committee with power to take action.

Donations for the Library were received from the Academies at Paris and Philadelphia; the Societies of Science at Emden and Hobarton; the Royal Astronomical Society, Geological Society, Society of Arts, and Board of Trade at London; the Institutes at Dresden, Utrecht, and Philadelphia; the University at Christiania, and of New York; the Museums at Nürnberg, and Peel Park; the Free Public Library at New Bedford; the booksellers Voight and Günther, of Weimar; Schmidt, Müldener, and Zuchold, of Göttingen; Norton, of New York; and Leypoldt, of Philadelphia.

Mr. Fraley announced the death of a member, Mr. George M. Justice, on the 14th inst., in the 70th year of his age. Mr. Letchworth was appointed to prepare an obituary notice of the deceased.

A letter was read from Dr. Tafel, of St. Louis, dated March, 1862, accompanying a manuscript history of the English Language, offered for publication by the Society, which, on motion, was referred to the same committee, consisting of Dr. Coates, Professor Alexander, and Professor Coppée, that had charge of the memoir of Dr. Tafel, lately published in the Proceedings.

Professor Coppée introduced the subject of Flax and the manufacture of Linen in the United States, the history of which was then given by Mr. Kimber, of Philadelphia, with the causes leading to its abandonment in 1857, and the difficulties, probability, and utility of its revival. Other members present then spoke of the substitution of Flax for Cotton, and of the growth of Cotton in the Northern States, in China, and elsewhere. Dr. Rogers hoped to see the fibre of the Flax become a substitute for Cotton, and based the hope upon their similarity under a microscope, and the fact that no perfect solvent for the cement between the fibres had been yet discovered. Dr. Coates referred to communications on the subject in the Proceedings of the Rhode Island Society, and to manuscripts in the possession of an absent member, Mr. Powel.

Mr. Peale submitted for inspection a large collection of the Stone implements of the Ancient Britons, which he had lately received from England; they were obtained from barrows in the North Riding of Yorkshire.

Mr. Dubois made the following communication respecting the average health of Philadelphia, in comparison with other cities.

The last edition of the Encyclopædia Britannica, in the article MORTALITY, contains a tabular statement, which, however accurate in other respects, is far from being correct in regard to Philadelphia. It professes to show (but without citing authorities), the ratio of deaths in every thousand of the population, per annum, in various cities of the world, arranging them in the order of healthfulness. Philadelphia stands pretty far down in the catalogue, and, as will surprise every one, quite below London and New York. Its annual mortality is stated to be 26.8 per thousand.

In point of fact, the mortality for the years 1859, 1860, and 1861, being averaged, shows an annual proportion of 21 to 1000, if the still-born are included; if not, about 20 to 1000. This result places Philadelphia near the top of the list, and agrees with the general impression on this side of the ocean. It may be remarked that the year just elapsed, although not visited by any great epidemics, was unusually fatal in Philadelphia.

It may be interesting to add, in this connection, that the *average*

duration of life, found by multiplying the various ages of the dying by their numbers respectively, and dividing the sum of the products by the whole population, is 23 years, in Philadelphia. Excluding those who die under one year, and who may be said not to have the stamina to begin the race of life, the average duration is 30¼ years. This small allotment, it is scarcely necessary to observe, arises from the large proportion of deaths under the age of five years; nearly one-half of the entire sum.

Pending nominations Nos. 446 to 455 and new nominations Nos. 456 and 457 were read.

Nominations Nos. 446 to 455 were ballotted for, and there being no other business before the Society, the ballot boxes were examined, and the following persons were declared by the presiding officer to have been duly elected members of the Society:

Professor F. L. OTTO RŒHRIG, of Philadelphia.

Lieutenant H. L. ABBOT, Corps of Topographical Engineers, United States Army.

Professor OSWALD HEER, of Zurich, Switzerland.

Professor JOHN LINDLEY, of London, F.R.S.

Professor JOHANN LIEBIG, of Munich, Bavaria.

Professor FRIEDRICH WÖHLER, of Göttingen, Germany.

Professor J. W. DAWSON, of Montreal, Canada.

Captain SAMUEL F. DUPONT, of the United States Navy.

Dr. GEORGE ENGLEMANN, of St. Louis, Missouri.

WILLIAM S. SULLIVANT, Esq., of Columbus, Ohio.

And the Society was adjourned.

Stated Meeting, May 2, 1862.

Present, seventeen members.

Vice-President, JUDGE SHARSWOOD, in the Chair.

Letters accepting membership, were received from Professor J. W. Dawson, of Montreal, dated April 23, 1862, and H. L. Abbot, Lieutenant United States Army, Topographical Engineers, dated Camp Winfield Scott, April 24, 1862.

Letters acknowledging publications sent were received from the Royal Academy and Royal Zoological Society at Amsterdam, dated February and October, 1860, and from the Leeds Philosophical and Literary Society, dated October 29, 1861.

Letters transmitting donations for the Library were received from the Royal Academy at Vienna, dated December 28, 1861; from the Royal Academy at Amsterdam, November 15, 1861; the Royal Zoological Society at Amsterdam, August, 1860; the Royal Society at Göttingen, February 12, 1862; Col. Bache, Washington, April 19; and James Lenox, of New York, April 25, 1862.

Donations for the Library were received from the Academies at Buda, Vienna, and Amsterdam; the Societies at St. Gall, Lausanne, Göttingen, Leeds, and Bath; the Royal Society, Royal Institution, Royal Astronomical and Asiatic Societies, and Society of Antiquarians, at London; the Geographical Societies of London and Vienna; the Geological Societies in Vienna, Leeds, and Dublin; the Zoological Society in Amsterdam; M. M. Troyon, of Lausanne; Pierragi, of Paris; James Lenox, of New York; Blanchard & Lea, of Philadelphia, and Col. Hartman Bache.

Dr. Goodwin made some remarks upon the Faculties of the Mind and Causation, which were followed by a general discussion of the subject.

And the Society was adjourned.

Stated Meeting, May 16, 1862.

Present, nineteen members.

Judge SHARSWOOD, Vice-President, in the Chair.

Prof. Roehrig, a lately elected member, was introduced by Mr. Lesley.

A letter, accepting membership, was read from S. F. Dupont, dated Wabash, Port Royal, May 8, 1862.

Letters acknowledging the receipt of publications was received from the New Jersey Historical Society, dated April

28, 1862; the Royal Society of Edinburgh, dated December 21, 1861; the Batavian Society at Rotterdam, dated September 30, 1861; the Boston Library, dated April 15, 1862.

A letter accepting the appointment to prepare an obituary notice of Mr. Justice, was received from A. S. Letchworth, dated Philadelphia, May 12, 1862.

Two letters respecting a communication offered for publication in the Transactions, were received from Dr. F. V. Hayden, dated Washington, April 29, and May 1, 1862.

A letter respecting the Michaux legacy was read from Dr. Wood, dated Paris, April 15, 1862, addressed to Judge King, as chairman of the special committee on that subject.

A letter requesting the librarian to make up a deficiency in the third volume of the Transactions for the Imperial Academy at St. Petersburg, was read from Baron R. Ostensacken, dated Washington, April 30, 1862.

A letter requesting the completion of the set of the Transactions from Volume III onwards (inclusive) for the Royal Institution, and to be placed on the list for the Transactions, was received from the Assistant Secretary and Keeper of the library, Benjamin Vincent, dated Albemarle Street, London, September 12, 1861. The librarian was directed to furnish the Transactions.

Donations for the library were received from the Bureau of Civil Engineers at Paris, the Royal Academy of Edinburgh, the Massachusetts Historical Society, the Franklin Institute, the New Jersey Historical Society, the Managers and Superintendents of the House of Refuge, Deaf and Dumb Institute, State Lunatic Asylum, Pennsylvania School for Feeble-minded Children, James J. Barclay, Ed. C. Jones, C. Sherman, and Joseph Lesley, of Philadelphia, Col. Hartman Bache, and Charles Ellet, Jr., of Washington.

Judge Sharswood announced the death of a member, Mr. Charles J. Ingersoll, at Philadelphia, on the 14th inst., aged 79. Judge Sharswood was appointed to prepare an obituary notice of the deceased.

Dr. Bache announced the death of another member, Dr. George W. Bethune, at Florence, on the 28th of April, aged

57. Dr. Dunglison was appointed to prepare an obituary notice of the deceased.

Mr. Lesley announced the death of a member of the Society, Prof. K. C. Von Leonhard, at Heidelberg, on the 23d of January, 1862, in the 83d year of his age.

A memoir was presented for the Transactions by Dr. Hayden, and referred to a committee, consisting of Dr. Leidy, Prof. Lesley, and Dr. Roehrig.

Prof. Lesley exhibited a manuscript map of the Alleghany Mountains on a large scale, and described especially the coal formation of Southern Virginia. He remarked that:

The coal region of Montgomery, Pulaski, Wythe, Washington, and Smith counties in Southern Virginia, is interesting in an economical as well as a geological sense. It furnishes species of semi-anthracite and semi-bituminous coal, which come in competition with the Oolitic bituminous coal of the Richmond basin, over the principal internal railroad of the Southern Atlantic States. This railroad penetrates the great primary range of mountains, the Blue Ridge, at Lynchburg, and then follows the course of the Great Valley, southwestward, to Knoxville and Chattanooga, in Eastern Tennessee. This Great Valley, of Lower Silurian limestone, extends from Newburg on the Hudson to Montgomery in Alabama, everywhere separating the range of the Blue Ridge, South Mountain, Smoky Mountain, or Black Hills, from the true Alleghanies or Appalachians. The rocks of the Blue Ridge Range, on the eastern side of the Valley, are a prolongation of the Green Mountains of Vermont, and consist of the Quebec group or Taconic system, now understood by Logan to be a thickening of the lowest Silurians (Calciferous Sandrock and Potsdam Sandstone or Primal Slates).* The Appalachian Mountains on its western side are Middle and Upper Silurian and Devonian formations. West of these rises the long high escarpment of the Carboniferous formation, forming the mountain plateau of Western Pennsylvania, Western Virginia, Eastern Kentucky, Central Tennessee, and Northern Alabama. The escarpment of this vast plateau, facing the east, and overlooking the Appalachian ranges, with their narrow, parallel, interval valleys, is the so-called Backbone Alleghany

* It is but just to say that the Rogerses maintained substantially this view before 1840, considering, as they did, the Blue Ridge System an enlargement merely of Formation No. I.

Mountain, beginning at Catskill on the Hudson, and ending in Alabama. The northern portion of this plateau is drained eastward by the branches of the Susquehanna, and westward by the branches of the Alleghany and Monongahela Rivers. All the waters of Middle Pennsylvania, Maryland, and Northern and Middle Virginia flow from the foot of this escarpment towards the Atlantic, breaking successively through the parallel Appalachian ridges of the subcarboniferous formations. The waters of the Tennessee River head also at the eastern foot of this escarpment, and flow along at its base for several hundred miles southwestward, before they turn west at Chattanooga, and break through its southern extremity, to make their great circuit through Alabama, Western Tennessee, and Kentucky to the Ohio River near its mouth. But in the middle of the region, namely, in Southern Virginia, its normal drainage is reversed. The New River heads in the Blue Range, crosses the Great Valley westward, breaks *into* (not *out of*) the Appalachians, striking the escarpment in its face, and flowing directly through and across it (as the Great Kanawha) through Western Virginia into the Ohio.

The cause of this phenomenon is to be found in a change of structure at this line. Most of the valleys and mountains north of it as far as New Jersey are unbroken anticlinals and synclinals. Most of the valleys and mountains to the south of it, as far as Alabama, are monoclinals, bounded by immense faults or downthrows.

The Appalachian Mountains of Southern Virginia and Eastern Tennessee are grouped in pairs by these faults. The country for three or four hundred miles northeast and southwest, and from thirty to forty miles from southeast to northwest, is fractured in parallel strips from five to six miles wide. Each strip is tilted at such an angle (dipping southeast) that at each fault the upper edge of one strip (with its Carboniferous rocks) abuts against the bottom or Lower Silurian edge of the strip next to it. As the Palæozoic system, thus revealed (on edge) between any two of these faults, contains two massive sandrock formations, No. IV, Middle Silurian, and No. X, Upper Devonian, there occur necessarily between each pair of faults a pair of parallel mountains. The Palæozoic zone, therefore, included between the Great Valley and the Backbone escarpment, is occupied by as many pairs of parallel mountains as there are great parallel faults; and as these faults range in straight lines at nearly equal distances from each other, these mountains run with remarkable uniformity, side by side, for a hundred or two hundred miles, and are finally cut off, either by short cross faults, or by slight angular changes in the courses of the great faults. Thus we get an explanation of the

very unusual arrangement of the head waters of the Tennessee River, in long parallel branches, with few subordinate affluents, suddenly uniting through mountain gorges, or at the ends of long mountains.

In each pair of Palæozoic mountains the eastern one carries a coal area on its seaward flank; because, the last formation to dip against each fault is the Coal at the top of the series, abutting against the Lower Silurian of the limestone valley which always exists on the eastern side of the fault; as seen in the accompanying diagram, representing a section made across three pairs of mountains just north of Wythe. (See Fig. A.)

The coal here represented, however, is not the coal of the Carboniferous formation, commonly so called.

Underneath the true coal measures of Pennsylvania, Ohio, and Northwestern Virginia, and underneath the Millstone Grit Conglomerate (No. XII) at its base, and the Red Shale formation (No. XI), which underlies the last, there begins, even in Pennsylvania, to appear an older coal formation, connected with the uppermost Devonian, white, mountain Sandstone, No. X. It is seen in one or two beds two feet thick at the head waters of the Juniata. It is mined where the Monongahela waters cut through Chestnut Ridge from Virginia into Western Pennsylvania. It has been mined in the mountains on the Potomac *below* Cumberland. It appears occasionally in Northern Middle Virginia, on the western side of the Great Valley of Winchester. It increases in importance along the western outcrop of the great coal field through Eastern Kentucky, until it enters Tennessee. It seems, however, to attain its maximum development in Montgomery county, on the New River, in Southern Virginia, near the line of our section. Here it is seen to consist of two principal coal-beds and several minor seams. The lowest bed reaches the thickness of four feet, and the next one above it is in some places nine feet thick. In the Peak Hills, just east of Wythe, along the line of the railroad, numerous lenticular deposits of coal are seen, and thin distorted beds, the whole composing a formation several hundred feet thick. Near the New River, the two beds above-mentioned are seen to be covered by at least a thousand feet of Red shale; upon which rests a Subcarboniferous limestone; which abuts, at the fault, against other limestones belonging to the Lower Silurian age. Between Christiansburg and Blacktown, north of New River, a regular synclinal coal-basin has been preserved for a few miles upon the eastern side of the great fault, which crosses the river in front of the gap. In this coal-basin the two beds of coal are preserved, but in a crushed condition. To the southwest, two faults cut off a similar short basin from the regular

coal formation on the mountain, throwing up a wedge of Lower Silurian Limestone, as in the section, Fig. B.

It is here that the relationship of these great faults to the normal anticlinals and synclinals of the Appalachian region can be studied to great advantage; the presence of cross faults at high angles being exhibited by the sudden termination of the mountains, and by the tearing open, as it were, of one side of anticlinal coves. The sketch of the topography north of Wytheville, in Fig. C., will show how this has been effected, and render further description needless.

The straitness of the mountains is sometimes interfered with by small cross undulations or faults (it is not easy to determine which they are), producing offsets and minute coves, notches, and sometimes gaps, as seen in Fig. F, representing a portion of the first pair of mountains west of Wytheville.

The "plaster banks" of the Holston, are deposits of rock salt and gypsum and red marl, in excavations along faults, two of which are transverse, and one parallel to the main fault, at the foot of the Little Clinch Mountain. Over this main fault the river flows, probably burying the outcrop of the coal, although it is possible that the fault itself may here have cut out the coal, see Figs. E, *b* and *c*. Fig. E, *a*, represents the coal, and the fault further east.

These gypsum deposits have no geological connection with the coal, however the analogy of the Michigan subcarboniferous gypsum and salt, and of the Nova Scotia gypsum deposits, might seem at first glance to suggest one. They are found along the valley for sixteen miles, but the principal deposit occupies the excavated axis of a broken anticlinal, in the lowest part of the Lower Silurian limestone. The plain of the Salt Works was once a triangular lake, scooped out of the soft, reddish sulphur-iron rocks of the base of the Palæozoic system, lifted to the surface by an anticlinal, terminated at its east or northeast end by a cross fracture, which lets the usual hard limestones of the valley settle down on the other side of it into their ordinary posture against the main fault. No plaster occurs above water-level. The Upper Banks occupy a cross fracture; and borings here, 500 feet deep, bring up salt water. At the Middle Banks, seven miles east of the Salt Works, the deposit seems to be on the line of the main fault. A mile from the Salt Works, it is dug on the small cross fault. At the Salt Works, the borings go down along the snap of the anticlinal, through 60 to 80 feet of plaster and red clay.

The decomposition of the sulphurets in these red rocks, have con-

verted the outcrop edges of the limestone, as well as the limestone clays and lime waters of the inflowings of the valley, into gypsum. There must have been standing pools along these excavated faults, or no deposits of solid gypsum and rock salt could have occurred. And the want of such, in other parts of this and the neighboring valleys has prevented similar deposits, especially in the great valley east of Wythe, where these lowest red rocks, with their sulphuret ores of iron and lead, appear at the surface in great force; and large quantities of these ores have been converted into peroxide of iron and carbonate of lead; no doubt by the loss of sulphuric acid, gone to produce gypsum, which has been carried off by the free drainage of the country. None of the main parallel faults of the back valleys, seem to bring these red rocks to the surface, except along the Holston; and even here, it required the crushing of the surface rocks along a supplementary anticlinal, to afford facilities, first for excavation, and then for decomposition.

It is possible, of course, that sulphur waters, issuing upwards along the line of the anticlinal and cross faults, may have assisted in the process; but there is no need to call in their assistance to explain the phenomenon, and such springs now are wanting elsewhere. On the other hand, masses of sulphuret of iron, inclosed in workable limonite ore, may be seen along the line, at Carleton Hill, twenty miles east of the Salt Works, and three miles east of large deposits of limonite ore of workable quality.

To account for the rock salt several hundred feet below the gypsum, seems more difficult. It lies in solid form, mixed and interstratified with compact red marl or clay, 200 feet below water-level; and the borings have gone down 176 feet further without reaching the bottom. Into this deep lake, the drainage of the Upper Devonian sandstones on one side of the fault, as well as of the Lower Silurian limestones on the other, must have always run and deposited their salt with mud and sand. But on top of the deposits of salt and mud was thrown down a stratum of blue slate more than a hundred feet thick; and over this again, the 60 to 80 feet of gypseous clays, until the lake was full. All this looks much more like a chemical than a mechanical precipitation.

The present connection of the mass of gypsum, mud, and salt with the Holston River, through underground crevices beneath the ridge of limestone which separates them, is apparent from the fact that water in all the wells not only always stands at the same level, but at the level of the river; nor does the heaviest pumping alter it.

The lower gypsum banks (Preston's) yielded in 1854, 2000 tons;

the cost at the mines being $3 per lump and $5 for ground plaster; eighty miles distant it has been sold for $20.

The yield in salt in 1853 was 300,000 bushels; 50 pounds to the bushel, and 6 bushels to the barrel, at 50 cents per bushel. Five furnaces were then running, and 24,000 gallons of brine pumped daily; 10,000 cords of wood supplied the fuel. Coal is now used, brought from the neighborhood of Wytheville by a branch railroad.

Southwest of Wythe, the coal is traceable in all the little ravines and gaps of the first mountain west of the Great Valley; and in the third mountain west of it, far beyond the celebrated salt deposit of Smith county, and into Tennessee; but the single bed is thin and crushed, and the coal worthless. In the Peak Hills country, east of Wythe, the coal is almost an anthracite, and has been exposed to such movements that it rattles like sand out of the shovel, and cannot, therefore, go to market. Otherwise it is pure and good. This condition is apparently connected with the appearance of a massive sand-rock under it, which forms a terrace and range of small peaks along the side of the mountain. The coal bed itself is of large size, consisting of the following layers:

Roof shale, sandy, several feet.	
Coal dirt and coal slate, ...	5 feet.
Yellow shale, two feet.	
Coal crushed to coarse dust, ...	2 feet.
Blue shale, &c., three feet.	
Coal crushed and coal slate, ...	2 feet.
Interval of twenty or thirty feet.	
Quarry rock.	

On the south side of the New River the two coal beds are opened at Cloyd's. Here the summit and mid-rib of the Brushy Mountain is a pebbly conglomerate of great thickness, dipping 45° south 34° east; over which, forming the southeastern slope of the mountain, are, first, yellowish flagstones; and then, soft clay slates; in all about 1200 feet thick, dipping the same way. Over these lies the "Quarry rock," a massive, gray, micaceous, quartzose sandstone, forming a line of little peaks. Ten feet above this is coal bed A, yielding about two feet of very bright pure semi-anthracite coal, much crushed and with the same dip. Thirty-five feet above A lies coal bed B, with its neat, undisturbed roof-rock of thin-bedded argillaceous sandstone, yielding about two and a half feet of good coal out of the following section:

	FEET.	INCHES.
Coal, good,		10
—— slate,	1	0
Coal, poor,	1	2
Coal, crushed and slate,		6
Coal, poor,		6
Coal, crushed and slate,	2	6
Coal, good,	1	10
Coal, good,		9—in all 9.1.

An outcrop of black slate seems to represent the place of a third bed of coal, about 50 feet above coal B. About 550 feet still higher, the red shales set in and continue for many hundred feet, all at the same dip of about 45°, with great regularity, until limestones appear just at the fault. This section is represented in Fig. H.

On the northeast side of New River, where it enters the gap, a minor fault, in the opposite direction, has downthrown the coal of the mountain, so as to cause the outcrop of coal A to disappear, with steep mountain dips. But coal B shows four feet of good solid coal, with five feet of slaty coal on top. (See Fig. D.)

At Poverty Gap, further east, both beds appear with a dip of about 17°⅃ south 13° east, 45 feet apart; A yielding 3 feet of excellent coal, and B eight feet thick, slaty and crushed on top, soft and sandy in the middle, and hard, fine, blacksmith coal 3 feet at the bottom. Cliffs of compact green sandstone, 40 feet high, tower over the gangway, and introduce (going east) a new feature in the vertical section. Here is observable the curious variety called "sand-coal;" rightly named, for it feels to the hand as if sanded over, but is apparently as pure and good as the rest.

At Brose's mill, still further east, the great fault can be distinctly seen, where the red shale over the cliff sandstone dips 30°⅃ southward, directly against the vertical Lower Silurian Limestone of the valley. At Knode's crossing, further east, the red shale side of the fault has been curved down so as to produce a plunge of red shale against the fault at an angle of 60°–70°. (See Figs. I. and J.)

At Millstone hollow (still going east), A yields 2.6 of good coal, and, 20 feet above it, B (under its cliffs) shows the following section :

	FEET.	INCHES.
Soft coal,		8
Slate and coal,	4	0
Soft coal,		10
Slate,	1	3
Coal,	3	0

In these and other mines on this side of the river, the variety of "sand-coal" always appears as a constant element in the section, but occupying sometimes the top and sometimes the middle or bottom of the bed. Everywhere, also, the coal of the small bed A (which has not this aspect) is recognized as the best. The lower part of B is the most reliable and productive. At the eastern end of the district, also the pebble-rock underneath A, is no longer recognizable, having slowly degenerated to a bed of clay slate or soft sandstone. But in its place, and at a much lower depth (about 200 feet) below A, appears a massive stratum of flinty gray sand-rock; from under which, at one place, painted water issues, and a coal seam is *reported.* This may correspond to a black slate stratum which is seen at one place (near Cloyd's) about 150 yards below coal A. Two beds at this horizon are also *reported* to exist at Shlusher's mines, in the little basin opposite Blacksburg.

In Price's Mountain, between Blacksburg and Christiansburg, the two coal beds with their slates, and the red shale formation above them, have been curiously let down, still in an anticlinal form, between two faults, so as to be inclosed between two valleys of Lower Silurian Limestone. (See Fig. G.)

These coal beds have been long known and dug at old openings long deserted and fallen in. Later gangways show the same coal as that in Brush Mountain, but more anthracitic, frangible, and crushed, dipping on the southern side of the anticlinal 25°↲ south 10° east; and on the northern, 70°–80°↲. Over Kyle's coal are thin, blue, shaly sand-rocks, full of fossil plants. Three or four separate beds appear to exist, but the dips vary somewhat. The area is small, and the coal of little or no value to a railroad trade.

The coal of Montgomery county, then, is a soft anthracite of a sandy grain, disposed to slaty structure, passing into a compact, smooth, conchoidal, quasicannel, but never, so far as I have seen, a true cannel coal. In one or two instances I noticed a prismatic structure, where the coal would be called and sold for semi-bituminous. In general it is a semi-anthracite, or a soft, flaming, white ash anthracite.

Portions of the beds exhibit numerous specks of sulphuret of iron, in flat discs, in the joints. No cubic crystals.

The chief use of the coal must be domestic, although its harder parts can compete in the Richmond market with Richmond coal, with blacksmiths and limeburners, and probably puddlers and furnace-keepers. But it will not be likely to go to sea, on account of its slack

waste and high per cent. of ash, and the competition of Pennsylvania portable anthracite.

The quantity available by gangways driven in from New River, Poverty Gap, and the other breaks in Brush Mountain, where the real supply is to be obtained for any future trade, is an important question, and the answer may be tabulated as follows:

A, being the amount above water-level of all gangways.

B, being the amount above water-level of Poverty Gap.

C, being the amount below water-level to the fault.

	A.	B.	C.	TOTAL.
1. Ten miles east of Poverty Gap,	850,000	1,560,000	11,500,000	12,910,000 tons.
2. Three to four miles west of Pov. Gap,		250,000	3,500,000	3,750,000 tons.
3. Two miles next New River Gap,	Much less coal.		2,000,000	2,000,000 + tons.
4. Five miles west of New River Gap,		750,000 +		

It is supposed that at 3 cents per ton per mile, a branch road exclusively for coal will pay 6 per cent on a capital, if its tonnage is at least double the number of dollars which the road has cost per mile. A road costing $15,000 should send over at least 30,000 tons per annum.

The data from which the above calculation is made, are as follows: The distance from Poverty Gap (the terminus of a branch road from Christiansburg) to Shlusher's, along the coal beds, is ten miles, 17,600 yards; the line of highest outcrops strait, the line of water-level gangway-mouths in the different ravines rises regularly eastward; the greatest breastings from the gangway, above water-level, at Poverty Gap, is 350 feet; the least breasting at Shlusher's is nothing; the height of Shlusher's coal crop above Poverty gangway, 250 feet; the loss by ravines at every half mile, say one-quarter; the average yield of B say 3 feet, of A 2 feet; loss in mining one-third.

Mr. Gerhard presented specimens of mammoth powder in use in Gunnery.

Pending nominations Nos. 456, 457, 458, and new nominations Nos. 459 to 465 were read.

The communication of Mr. Prettyman was referred to a committee consisting of Prof. John C. Cresson, Mr. Peale, and Mr. Baldwin.

And the Society was adjourned.

The following Chapter in Professor Tafel's communication, entitled "Investigations into the Laws of English Orthography and Pronunciation," was not received in time for publication in its proper place, following page 376 of Vol. VIII.

CHAPTER XIII.

THE ELEMENTARY SOUNDS OF THE ENGLISH LANGUAGE, REPRESENTED IN WRITING.

§ 47. I HAVE now examined the mode in which the elementary sounds of the English language are formed by the organs of speech. I have investigated the manner in which they combine with one another in the formation of syllables; and I have finally shown the process by which the syllables are connected so as to form words. The only subject that yet remains for discussion in connection with the physiological part of the English language is accent; for by accent the words are imbued, as it were, with living breath, or are individualized, and by it they are prepared for their work of expressing the human thought. English accent, however, is such an extensive subject that I reserve its discussion for a future part of my investigations. Meanwhile, I shall exhibit the various methods resorted to in the English language for the expression of the several elementary sounds of speech. In the preparation of this chapter I have been assisted very much by the works of the phoneticists, such as Ellis, Comstock, etc., who have taken particular pains in collecting all those instances, in which the English language, according to their ideas, has sinned against the rules of sound spelling.

The elementary vowel-sounds of the English language have been collected in § 6, in the following table:

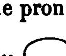
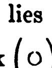
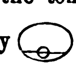
LONG.	SHORT.	LONG.	SHORT.
1. *father*, . .	———. . .	8. *sheep*,	. 9. *ship*,
2. *fast*, . .	3. *fat*, . . .	10. *pool*, *flute*,	. 11. *pull*,
4. *age*, *bane*, .	5. *end*, . . .	12. *note*,	. ———.
6. *fare*, . .	7. *fell*, *let*, .	13. *off*, *all*,	. 14. *not*, *what*.

15. *her*, *bird*, either long or short.
16. *love*, *but*, always short.

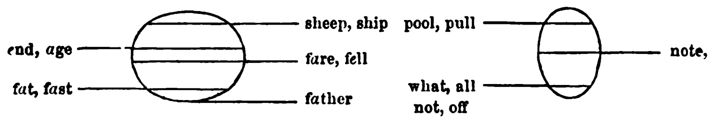
[REM.—The only departure I allowed myself in the present table,

is that of regarding the vowels *e* in *end* and *fell* as two distinct sounds; the former as the corresponding short sound of *a* in *age*, and the latter of *a* in *fare*. In § 6, I was inclined to regard them as identical, or almost so, because in some individuals whose pronunciation I then studied, I could not detect any difference between them; they gave to both vowels a sort of middle sound between *a* in *age* and *fare*. Upon reconsidering this subject lately, and examining the pronunciation of other careful speakers of the English language, I came to the conclusion that there does exist a difference in the pronunciation of these two sounds in the English as well as in the German, French, and other languages. In order to prove that the same distinction of sound which exists between the long sounds of *a* in *fate* and *fare*, continues among the short sounds, compare the sounds of *e* in *end* and *let*, and this is best done by starting with the words *bane* and *late* (where the vowel *a* is pronounced alike), and winding up with the words *end* and *let*, thus *bā-ĕnd, lā-ĕt*. By doing so, it will be found that the sound of *e* in *end* is but a continuation of *a* in *bane*, while that of *e* in *let*, is broader than *a* in *late*.]

In the above table I have not endeavored to express the various vowel-sounds by peculiar signs, but I have limited myself to collecting such words in which these sounds are exhibited; but henceforth it will be necessary to represent these sounds abstractly from the words in which they occur, and for this purpose I propose the signs introduced in the next table.—These are not arbitrary signs, but each represents the shape of the mouth, and the position of the tongue in the pronunciation of the several vowel-sounds.

In taking an external view of the shape of the mouth in the pronunciation of the several vowel-sounds, we see that in the pronunciation of the vowels from 1 to 9, the mouth is extended, viz., , but in the pronunciation of the vowels from 10 to 14 it is contracted, viz., . Also, in the diagram of § 6, which delineates the position of the tongue in the pronunciation of each of these sounds, we see that in the pronunciation of *a* in *father*, the tongue lies flat in the mouth; therefore, the sign , in which the mark  denotes the position of the tongue, will be used for the representation of this sound. In the pronunciation of *a* in *fast* the tongue is slightly raised; this sound, therefore, is represented by ; and so forth.

The following diagrams will furnish a key for these signs:



Of the two marks used in pointing out the position of the tongue, the one which is white, viz., (o), represents the long vowels, and the other which is black, viz., (●), the short: these marks are borrowed from musical notation.

As regards the names by which to call the signs, I propose to follow the same plan which is pursued in the alphabet. Thus *a* in *age* will be called long *ā*, and its corresponding short sound, viz., *e* in *end*, short *ă*; *o* in *note*, will be called long *o*; *a* in *father*, long *ah*; *a* in *fast* or *aft*, long *a(ft)*; and *a* in *fat*, short *a(ft)*—the two consonants in brackets are not to be pronounced, but the vowel *a* is to receive that sound which it has in *aft*. *A* in *fare*, and *e* in *fell*, I call *ai (r)*; *a* in *all* and *what*, or *o* in *off* and *not*, *au*, or *awe*, and *u* in *flute* and *pull*, *oo*.

The above table, containing the long and short vowels in use in the English language, may therefore be expressed with the following signs and names:

1. = long *ah*,	—
2. = long *a* (ft),	3. = short *a* (ft),
4. = long *ā* (ge),	5. = short *ā* (ge),
6. = long *ai* (r),	7. = short *ai* (r),
8. = long *ee*,	9. = short *ee*,
10. = long *oo*,	11. = short *oo*,
12. = long *o*,	—
13. = long *aw*,	14. = short *aw*,
15. = *ur* (*fur*),	16. = short *u* (p).

In the pronunciation of No. 16, which is the unmodified vowel-

sound, the tongue occupies no particular position, but the mouth has its round shape; it is therefore represented thus, . In No. 15, which is an amalgamation of the unmodified vowel-sound with the smooth *r*, the mouth is slightly contracted, as in the pronunciation of *bird;* it will, therefore be represented thus: , and as its sound may either be protracted or shortened *ad libitum*, without altering the word any, this quality will be expressed by a combination of the black with the white mark. In calling this sound by name, I propose to pronounce the vowel together with the following *r*, viz., *ur* in *fur*.

§ 48. I now proceed to give the English spelling of the several elementary sounds in use in the English language.

a. VOWELS AND DIPHTHONGS.

1. = long *ah:*

By *a*, as in *arm*, *father*,
" *ah*, " *ah!*
" *e*, " *sergeant*,
" *ea*, " *heart*,
" *aa*, " *to baa*,
" *i*, " *reservoir*.

2. = long *a* (ft):

By *a*, as in *aft*, *grass*, *calf*,
" *au*, " *laugh*.

3. = short *a* (ft):

By *a*, as in *black*, *at*,
" *ai*, " *plaid*.

4. = *ā* (ge):

By *a*, as in *chaos*, *aye*,
" *aa*, " *haak*, *Aaron*,
" *ae*, " *Gaelic*,
" *ai*, " *aim*, *hail*,
" *ao*, " *gaol*,
" *ay*, " *day*,
By *ea*, as in *great*,
" *ei*, " *veil*,
" *ey*, " *they*.

5. = short *a* (ge):

By *e*, as in *end*,
" *ea*, " *cleanse*,
" *ey*, " *Reynolds*,
" *ie*, " *friend*,
" *a*, " *Thames*.

6. = long *ai* (r):

By *a*, as in *fare*,
" *ai*, " *fair*,
" *e*, " *there*,
" *ea*, " *bear*.

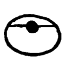
7. = short *ai* (r):

By *e*, as in *bell*, *let*,
" *ea*, " *health*, *head*,
" *ei*, " *heifer*,
" *eo*, " *leopard*,
" *a*, " *any*,
" *ae*, " *Pæstum*,

By *ai*, as in *said*,
" *ay*, " *says*,
" *oe*, " *fœtitude*.

8.  = long *ee*:

By *e*, as in *eve*, *fever*,
" *ea*, " *pea*, *heap*,
" *ee*, " *glee*, *feed*,
" *ei*, " *seize*, *ceiling*,
" *eo*, " *people*,
" *ey*, " *key*,
" *ae*, " *paean*,
" *ay*, " *quay*,
" *i*, " *machine*,
" *ia*, " *caviar*,
" *ie*, " *field*, *pier*,
" *oe*, " *diarrhœa*.

9.  = short *ee*:

By *i*, as in *is*, *big*,
" *y*, " *hymn*,
" *ee*, " *been*,
" *ei*, " *teint*,
" *o*, " *women*,
" *u*, " *busy*,
" *ui*, " *build*.

10.  = long *oo*:

By *o*, as in *lose*, *prove*,
" *oe*, " *shoe*,
" *oo*, " *too*, *mood*,
" *ou*, " *wound*, *soup*,
" *u*, " *flute*, *rude*,
" *ue*, " *flue*, *rue*,
" *ui*, " *fruit*,
" *ew*, " *blew*,
" *oeu*, " *manœuvre*.

11.  = short *oo*:

By *o*, as in *wolf*,
" *u*, " *put*, *full*,
" *oo*, " *wood*, *book*,
" *ou*, " *would*.

12.  = long ō:

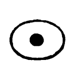
By *o*, as in *so*, *note*, *old*,
" *oa*, " *oar*, *goat*,
" *oe*, " *foe*, *toe*,
" *oo*, " *floor*, *door*,
" *ou*, " *four*, *mourn*,
" *ow*, " *flow*, *bowl*,
" *oh*, " *oh!*
" *eo*, " *yeomen*,
" *ew*, " *sew*,
" *eau*, " *beau*,
" *au*, " *hautboy*.

13.  = long *au*:

By *a*, as in *all*, *talk*,
" *au*, " *laud*,
" *aw*, " *law*,
" *o*, " *off*, *loss*,
" *oa*, " *broad*,
" *ou*, " *ought*.

14.  = short *au*:

By *o*, as in *lock*,
" *a*, " *what*,
" *ow*, " *knowledge*.

15.  = *u*(p):

a. *In accented syllables.*

By *u*, as in *up*, *but*,

By *o*, as in *love*, *son*,
" *oe*, " *does*,
" *oo*, " *blood*,
" *ou*, " *tough*,

b. *In unaccented syllables.*

By *a*, as in A-*fresh'*, *men'*ACE,
" *ai*, " *cap'tain*,
" *e*, " *bul'l*E*-tin*, *di'*E*t*,
" *ei*, " *sur'feit*,
" *ey*, " *al'ley*,
" *i*, " *abil'*I*-ty*, *ru'*I*n*,
" *y*, " *tru'l*Y,

By *o*, as in *fel'*o*-ny*, *pur'*p*o*s*e*,
" *oi*, " *por'poise*,
" *ou*, " *fa'mous*,
" *u*, " *dep'*U*-ty*, *cen's*US.

16. o = *ur* (fur).

By *er*, as in *her*, *herd*,
" *ir*, " *bird*, *fir*,
" *or*, " *word*, *worth*,
" *ur*, " *fur*, *burn*,
" *our*, " *journey*.

§ 49. The table of *diphthongs* is found in § 8.

1. **ae**, in *aisle*, etc.
2. əi, in *height*, etc.
3. **ao**, in *spouse*, *fowl*, etc.
4. ə**u**, in *gout*, *stout*,
5. **a°ɛ**, in *toil*, *boy*,
6. **iu**, in *cue*, *tube*.

(Concerning the characters used in describing the diphthongs, see § 8, in the beginning.)

These diphthongs are spelled in the English language in the following manner:

1. **ae**:
By *i*, as in *child*, *hide*, *sign*, *high*,
" *y*, " *by*, *rhyme*,
" *ie*, " *pie*,
" *ye*, " *rhye*,
" *ei*, " *eider*,
" *eye*, " *eye*,
" *ui*, " *guide*,
" *uy*, " *buy*.

2. əi:
By *i*, as in *sight*, *side*, *indict*,
" *y*, " *scythe*,
" *ei*, " *height*.

3. **ao**:
By *ou*, as in *our*, *mouse*, *bough*,
" *ow*, " *now*, *fowl*.

4. əu:
By *ou*, as in *gout*, *doubt*,
" *ow*, " *bower*.

5. **a°ɛ**:
By *oi*, as in *toil*,
" *oy*, " *boy*.

6. **iu**:
By *u*, as in *tube*, *Hugh*,
" *ue*, " *due*,
" *ui*, " *juice*,
" *eu*, " *feud*,
" *ew*, " *few*,
" *eau*, " *beauty*,
" *ieu*, " *lieu*,
" *iew*, " *view*,
" *you*, " *you*.

b. Consonants.

§ 50. The consonants of the English language, which have been described in Chapter V., are represented in writing in the following manner:

Labials.

1. *The hard consonant:*

By *p*, as in *pit, hop,*
" *pp*, " *happy,*
" *gh*, " *hiccough,*
" *ph*, " *diphthong.*

2. *The soft consonant:*

By *b*, as in *bow, sob,*
" *bb*, " *ebb, robber.*

3. *The non-sonant fluid consonant:*

By *f*, as in *fame, safe,*
" *ff*, " *off, traffic,*
" *ph*, " *phial, graphic,*
" *pph*, " *Sappho,*
" *gh*, " *laugh.*

4. *The sonant fluid consonant:*

By *v*, as in *vie, have,*
" *f*, " *of,*
" *ph*, " *Stephen.*

Dentals.

1. *The hard consonant:*

By *t*, as in *top, at,*
" *tt*, " *Pitt, butter,*
" *th*, " *thyme, phthisic,*
" *d*, " *stopped,*
" *pt*, " *ptisan,*
" *ct*, " *ctenoid.*

2. *The soft consonant:*

By *d*, as in *day, bad,*
" *dd*, " *add, bladder,*
" *bd*, " *bdellium.*

3. *Fluid consonants of the first series:*

a. *Non-sonant:*

By *th*, as in *thunder, wrath,*
" *phth*, " *apophthegm.*

b. *Sonant:*

By *th*, as in *then, leather.*

4. *Fluid consonants of the second series:*

a. *Non-sonant:*

By *s*, as in *sin, case,*
" *c*, " *cent, fence,*
" *ss*, " *hiss, passing,*
" *sc*, " *scene,*
" *sch*, " *schism,*
" *st*, " *glisten, thistle,*
" *ps*, " *psalm,*
" *x*, " *beaux.*

b. *Sonant:*

By *z*, as in *zeal, seize,*
" *s*, " *his, rose,*
" *c*, " *suffice,*
" *x*, " *xanthic,*
" *cz*, " *czar,*
" *sc*, " *discern,*
" *ss*, " *scissors,*
" *zz*, " *buzz.*

5. *Fluid consonants of the third series:*

a. *Non-sonant:*

By *sh*, as in *shade, fish*,
" *shi*, " *fashion*,
" *ch*, " *machine*,
" *c*, " *officiate*,
" *ci, ce*, " *social, ocean*,
" *s*, " *sure, nausea*,
" *si*, " *mersion*,
" *t*, " *satiate*,
" *ti*, " *nation*,
" *sc*, " *fascia*,
" *ss*, " *cassia*,
" *ssi*, " *accession*.

b. *Sonant:*

By *z*, as in *azure*,
" *s*, " *treasure*,
" *si*, " *fusion*,
" *ti*, " *transition*.
By *ssi*, as in *scission*.

GUTTURALS.

1. *Hard consonant:*

By *k*, as in *keep, freak*,
" *c*, " *cap, frolic*,
" *q*, " *queen*,
" *qu*, " *pique, liquor*,
" *cc*, " *hiccough*,
" *ck*, " *black, jacket*,
" *ch*, " *chord, ache*,
" *gh*, " *lough*.

2. *Soft consonant:*

By *g*, as in *go, log*,
" *gg*, " *fagged, laggard*,
" *gu*, " *rogue, guide*,
" *gh*, " *ghost*,
" *ck*, " *blackguard*.

c. SEMI-VOWELS AND VOWEL-CONSONANTS.

§ 51. 1. *R-sound.*

By *r*, as in *roll, pair*,
" *rr*, " *burr, marry*,
" *rrh*, " *myrrh*,
" *rt*, " *mortgage*,
" *wr*, " *write*.

2. *L-sound.*

By *l*, as in *light, file*,
" *ll*, " *ball, alley*,
" *ln*, " *kiln*.

3. *Labial Nasal:*

By *m*, as in *mind, flame*,
" *mm*, " *mammon*,
" *mn*, " *hymn*,
" *mb*, " *lamb, lambda*,
" *mp*, " *contempt*,
" *tm*, " *tmesis*.

4. *Dental Nasal:*

By *n*, as in *no, man*,
" *nn*, " *Ann, banner*,
" *mn*, " *mnemonics*,
" *pn*, " *pneumatics*,
" *kn*, " *know*,
" *cn*, " *Cneus*,
" *gn*, " *gnaw*.

5. *Guttural Nasal:*

By *n*, as in *thank*,
" *ng*, " *thing*,
" *ngue*, " *tongue*.

6. *Labial Vowel-consonant:*

By *w*, as in *wife, woo*,
" *u*, " *quill, suavity*,
" *o*, " *reservoir*,
" —, " *one*.

7. *Palatal Vowel-consonant:*
By *y*, as in *year, you,*
" *i*, " *million, onion,*
By *j*, as in *hallelujah,*
" *e*, " *ewe, hew,*
" —, " *use.*

d. Consonantal Diphthongs.

§ 52. With regard to the consonantal diphthongs, their spelling is found under the head of the single consonants of which they are composed, with the exception of the following combinations, where peculiar characters are used for their representation:

1. *tsh:*
By *ch*, as in *church,*
" *tch*, " *fetch,*
" *t*, " *nature,*
" *ti*, " *question.*

2. *dzh:*
By *g*, as in *gentle, Gipsy,*
" *ge, gi*, " *George, legion,*
" *dge*, " *bridge,*
" *dg*, " *judgment,*
" *j*, " *judge,*
" *di*, " *soldier,*
" *ch*, " *ostrich.*

3. *ks:*
By *ks*, as in *steaks,*
" *cks*, " *bricks,*
" *cs*, " *mimics,*
" *x*, " *exile,*
" *cc*, " *accent.*

4. *gz:*
By *x*, as in *example,*
" *gs*, " *figs,*
" *ggs*, " *eggs.*

5. *ts:*
By *ts*, as in *kits,*
" *z*, " *mezzotinto.*

§ 53. Thus far the characters have been exhibited by which the several elementary sounds of the English language are represented in writing; I now invert this exhibition, and intend to show the number of elementary sounds, expressed by the single and double characters of English orthography.

a. *Simple Vowel-signs.*

A has 10 *sounds:*
1. *a*, as in *all, stalk,*
2. *a*, " *what,*
3. *a*, " *arm,*
4. *a*, " *fast, sand,*
5. *a*, " *fat,*
6. *a*, " *flare,*
7. *a*, " *ale,*
8. *a*, " *any,*
9. *a*, " *Thames,*
10. *a*, " *a-fresh, men'ace.*

E has 6 *sounds:*
1. *e*, as in *there,*
2. *e*, " *bell,*
3. *e*, " *end,*
4. *e*, " *her,*
5. *e*, " *eve,*
6. *e*, " *bul'lE-tin, diEt.*

I has 6 *sounds:*
1. *i*, as in *caprice,*
2. *i*, " *is, big,*

3. *i*, as in *sir, bird,*
4. *i*, " *child, file,*
5. *i*, " *reservoir,*
6. *i*, " *ru'in.*

U has 8 *sounds:*

1. *u*, as in *flute,*
2. *u*, " *pull,*
3. *u*, " *but, up,*
4. *u*, " *hurry,*
5. *u*, " *busy,*
6. *u*, " *tube,*
7. *u*, " *suavity,*
8. *u*, " *cen'sUs.*

O has 12 *sounds:*

1. *o*, as in *old,*
2. *o*, " *nor,* (?)
3. *o*, as in *off,*
4. *o*, " *lock,*
5. *o*, " *love,*
6. *o*, " *word,*
7. *o*, " *women,*
8. *o*, " *lose,*
9. *o*, " *wolf,*
10. *o*, " *one,*
11. *o*, " *reservoir,*
12. *o*, " *pur'pose.*

Y has 5 *sounds:*

1. *y*, as in *yoke,*
2. *y*, " *hymn,*
3. *y*, " *myrrh,*
4. *y*, " *by,*
5. *y*, " *envy.*

b. *Compound Vowel-signs, or Digraphs.*

AA has 2 *sounds:*

1. *aa*, as in *baa, Aar,*
2. *aa*, " *Aaron.*

AE has 4 *sounds:*

1. *ae*, as in *Gaelic, Maese,*
2. *ae*, " *Aetna,*
3. *ae*, " *Caesar,*
4. *ae*, " *aerial.*

AI has 6 *sounds:*

1. *ai*, as in *aim,*
2. *ai*, " *air,*
3. *ai*, " *said,*
4. *ai*, " *plaid,*
5. *ai*, " *aisle,*
6. *ai*, " *cap'tain.*

AO has 3 *sounds:*

1. *ao*, as in *gaol,*
2. *ao*, as in *extraordinary,*
3. *ao*, " *aorist.*

AU has 4 *sounds.*

1. *au*, as in *fault,*
2. *au*, " *aunt, laugh,*
3. *au*, " *gauge,*
4. *au*, " *hautboy.*

AW has 1 *sound:*

1. *aw*, as in *awl.*

AY has 4 *sounds:*

1. *ay*, as in *day,*
2. *ay*, " *says,*
3. *ay*, " *quay,*
4. *ay*, " *ay.*

EA has 8 *sounds:*

1. *ea*, as in *beast,*

2. *ea*, as in *great*,
3. *ea*, " *cleanse*,
4. *ea*, " *bear*,
5. *ea*, " *bread*,
6. *ea*, " *earth*,
7. *ea*, " *heart*,
8. *ea*, " *real*.

EE has 5 *sounds:*

1. *ee*, as in *free*,
2. *ee*, " *breeches*,
3. *ee*, " *ne'er*,
4. *ee*, " *Beelzebub*,
5. *ee*, " *seer*.

EI has 8 *sounds:*

1. *ei*, as in *deceive*,
2. *ei*, " *surfeit*,
3. *ei*, " *veil*,
4. *ei*, " *heir*,
5. *ei*, " *heifer*,
6. *ei*, " *cider*,
7. *ei*, " *height*,
8. *ei*, " *being*.

EO has 5 *sounds:*

1. *eo*, as in *people*,
2. *eo*, " *leopard*,
3. *eo*, " *George*,
4. *eo*, " *yeoman*,
5. *eo*, " *feod*.

EU has 2 *sounds:*

1. *eu*, as in *feud*,
2. *eu*, " *rheum*.

EW has 3 *sounds:*

1. *ew*, as in *pew*,
2. *ew*, " *drew*,
3. *ew*, " *sew*.

EY has 3 *sounds:*

1. *ey*, as in *key*,
2. *ey*, as in *they*,
3. *ey*, " *alley*.

IA has 1 *sound:*

1. *ia*, as in *caviar*, (*cavîr*).

IE has 4 *sounds:*

1. *ie*, as in *pie*,
2. *ie*, " *field*,
3. *ie*, " *sieve*,
4. *ie*, " *friend*.

OA has 4 *sounds:*

1. *oa*, as in *boat*,
2. *oa*, " *oatmeal*,
3. *oa*, " *cupboard*,
4. *oa*, " *broad*.

OE has 6 *sounds:*

1. *oe*, as in *shoe*,
2. *oe*, " *toe*,
3. *oe*, " *does*,
4. *oe*, " *foetus*,
5. *oe*, " *foetid*,
6. *oe*, " *doer*.

OI has 6 *sounds:*

1. *oi*, as in *boil*,
2. *oi*, " *turkois*,
3. *oi*, " *choir*,
4. *oi*, " *scrutoir*,
5. *oi*, " *reservoir*,
6. *oi*, " *porpoise*.

OO has 4 *sounds:*

1. *oo*, as in *cool*,
2. *oo*, " *book*,
3. *oo*, " *blood*,
4. *oo*, " *floor*.

Ou has 9 sounds:

1. *ou*, as in *arouse*,

2. *ou*, as in *gout*,
3. *ou*, " *ought*,
4. *ou*, " *course*,
5. *ou*, " *rough*,
6. *ou*, " *journey*,
7. *ou*, " *youth*,
8. *ou*, " *could*,
9. *ou*, " *famous*.

OW has 3 sounds:

1. *ow*, as in *now*,
2. *ow*, " *flow*,
3. *ow*, " *knowledge*.

OY has 1 sound, as in *boy*.

UE has 2 sounds:

1. *ue*, as in *due*,
2. *ue*, " *blue*, *rue*.

UI has 5 sounds:

1. *ui*, as in *juice*,
2. *ui*, " *fruit*,
3. *ui*, " *build*,
4. *ui*, " *guile*,
5. *ui*, " *ruin*.

UY has one sound, as in *buy*.

YE has one sound, as in *rye*.

c. *Triple Vowel-signs, or Trigraphs.*

AYE has one sound, as in *aye*.

EAU has 2 sounds:

1. *eau*, as in *beauty*,
2. *eau*, " *beau*.

EYE has one sound, as in *eye*.

IEU has 3 sounds:

1. *ieu*, as in *adieu*,
2. *ieu*, as in *Messieurs*,
3. *ieu*, " *lieutenant*.

IEW has one sound, as in *view*.

OEU has one sound, as in *manoeuvre*.

UOY has one sound, as in *buoy*.

d. *Simple Consonantal and Semi-vowel Signs.*

This table includes all simple signs of the English alphabet, with the exception of the vowel-signs.

B represents one sound, as in *boy*, *babe*.

It is mute:

In *bd*, as in *bdellium*,
" *bt*, " *doubt*, *subtle*,
" *mb*, " *dumb*, *climb*.

C represents 5 sounds:

1. *c*, as in *cap*, *arc*,
2. *c*, " *cent*, *cider*,
3. *c*, as in *suffice*,
4. *c*, " *ocean*,
5. *c*, " *cicerone*.

It is mute:

In *ct*, as in *victuals*, *indict*.

D represents 3 sounds:

1. *d*, as in *day*, *bad*,
2. *d*, " *hopped*,
3. *d*, " *soldier*.

It is mute in *handkerchief*, *Wednesday*, etc.

F represents 2 sounds:
1. *f*, as in *fame*, *life*,
2. *f*, " *of*.
It is mute in *halfpenny*.

G represents 5 sounds:
1. *g*, as in *go*, *log*,
2. *g*, " *gem*, *gill*,
3. *g*, " *rouge*,
4. *g*, " *poignant*,
5. *g*, " *long*.
It is mute:
In *gl*, as in *oglio*,
" *gm*, " *phlegm*,
" *gn*, " *gnarl*, *bagnio*.

H represents 1 sound, as in *hat*, *help*.
It is mute, as in *humble*, *heir*.

J represents 2 sounds:
1. *j*, as in *join*,
2. *j*, " *hallelujah*.

K represents 1 sound, as in *keep*, *break*.
It is mute, as in *know*, *knight*.

L represents 2 sounds:
1. *l*, as in *life*, *bold*,
2. *l* (*r*) as in *colonel*.
It is mute:
In *ld*, as in *could*, *chaldron*,
" *lf*, " *calf*,
" *lk*, " *talk*,
" *lm*, " *calm*,
" *ls*, " *halser*.

M represents 2 sounds:
1. *m*, as in *man*, *from*,
2. *m*, as in *comptroller*.
It is mute, as in *mnemonics*.

N represents 2 sounds:
1. *n*, as in *no*, *nun*,
2. *n*, " *ink*.
It is mute:
In *mn*, as in *hymn*, *limn*,
" *ln*, " *kiln*.

P represents 2 sounds:
1. *p*, as in *pit*, *top*,
2. *p*, " *cupboard*.
It is mute:
In *pn*, as in *pneumatic*,
" *pph*, " *sapphire*,
" *ps*, " *psalm*,
" *pt*, " *ptisan*, *receipt*, *attempt*,
" *rps*, " *corps*.

Q represents 1 sound, as in *quill*.

R represents 2 sounds:
1. *r*, as in *row*,
2. *r*, " *her*.
It is mute:
In *rl*, as in *Marlborough*,
" *rs*, " *worsted*.

S represents 4 sounds:
1. *s*, as in *sick*,
2. *s*, " *close*,
3. *s*, " *nausea*,
4. *s*, " *treasure*.
It is mute:
In *sl*, as in *aisle*, *isle*,
" *sn*, " *demesne*,
" *sc*, " *viscount*; at the end of words, as in *chamois*, *corps*.

T represents 3 sounds:
1. *t*, as in *tin*, *pit*,

2. *t*, as in *nation*,
3. *t*, " *feature*.

It is mute:

In *st*, as in *christen*, *chestnut*, *waistcoat*, *castle*.
" *rt*, as in *mortgage;* at the end of words, as in *ragout*, *depot*.

V represents 1 sound, as in *vile*, *love*.

W represents one sound, as in *wise*.

It is mute:

In *wr*, as in *write*,
" *sw*, " *sword*, *answer*,
" *tw*, " *two*.

Y (see among vowels.)

Z represents 3 sounds:

1. *z*, as in *zeal*, *freeze*,
2. *z*, " *azure*,
3. *z*, " *mezzotint*.

e. *Compound Consonant-signs.*

Ch has 4 sounds:

1. *ch*, as in *church*,
2. *ch*, " *ostrich*,
3. *ch*, " *champaign*,
4. *ch*, " *ache*, *Christ*.

It is mute, as in *drachm*, *yacht*.

Ck has 2 sounds:

1. *ck*, as in *back*, *brick*,
2. *ck*, " *blackguard*.

Gh has 4 sounds:

1. *gh*, as in *ghost*,
2. *gh*, " *laugh*, *rough*,
3. *gh*, " *hough*, *lough*,
4. *gh*, " *hiccough*.

It is mute, as in *Armagh*, *usquebaugh*, *weigh*, *nigh*, *bough*, *though*, *through*, *Hugh*.

Ng has 2 sounds:

1. *ng*, as in *thing*,
2. *ng*, " *finger*.

Ph has 4 sounds:

1. *ph*, as in *phial*, *Joseph*,
2. *ph*, as in *Stephen* (v).
3. *ph*, " *aphelion* (f-h).
4. *ph*, " *diphthong* (p).

Sc has 4 sounds:

1. *sc*, as in *scour*, *sceptic*,
2. *sc*, " *scene*,
3. *sc*, " *conscience*,
4. *sc*, " *discern*.

Sch has 2 sounds:

1. *sch*, as in *school*,
2. *sch*, " *schism*,

Sh has one sound, as in *ship*, *fish*.

Th has 3 sounds:

1. *th*, as in *thank*, *bath*,
2. *th*, " *than*, *mother*,
3. *th*, " *thyme*, *isthmus*.

X has 4 sounds:

1. *x*, as in *expect*, *exile*,
2. *x*, " *example*,
3. *x*, " *beaux*,
4. *x*, " *xanthic*.

After thus showing the full extent of the field of my investigations, and after giving to the reader some idea of the work before me, I close this first part. In the next I shall commence the work of solving the problem of English pronunciation and orthography, beginning with a history of the formation of the English tongue.

NOTE.

The Committee beg leave to append to the above the following note:

With regard to the character, so generally ascribed in Germany, of greater softness to the sounds of "d," "g," and "b," when respectively compared with those of "t," "k," and "p," it appears to the members of the committee that the production of the latter sounds is accompanied with less force of breath and of the muscular action of the tongue, and is accompanied with a larger volume of intonation than that of the former. It therefore seems to them that the character of greater hardness, rather than of softness, would be naturally attached to "d," "g," and "b." They would ask whether, instead of the more recent ascriptions of softness and hardness, and if we reject the scholastic distinctions of slender, middle, and rough, tenues, mediæ and aspiratæ, *ψιλά, μέσα,* and *δασέα,* a more correct idea would not be given by the use, in this case, of the words delicate or well-defined, as applies to "t," "k," and "p," and coarser, to "d," "g," and "b."

They observe in this, as in some other works of great learning and just reputation, from the German school, a prevailing or total omission of the theta and the aspirated delta, or Anglo-Saxon ð, as they occur in the English words "thick" and "this." The committee avoid the inquiry whether the pronunciation of the Latin contained these sounds, and of the authority, in this respect, of the Greek, kept up as a living language to our days; but certainly the theta and the aspirated delta cannot be rejected from the English. They do not appear to the committee as hissing sounds, but *sui generis.* They seem to be produced by protruding the tongue quite beyond the edge of the incisor teeth, and then emit-

ting a more delicate current of voice, prevented from forming the sound of "s" or "z" by the approach of the soft surface of the tongue so near as to render the sound quite smooth.

What are called the long English vowels, "a," "i," and "o," appear to the committee to be, in each instance, diphthongal; and they think that this will appear if these vowels are much prolonged in their pronunciation. Thus, if we express the force of "e" in the English word "there" by the character "ê," and the common sound of "e," as in "me," by the simple letter "e," long "a" will appear to be composed, consecutively, of "ê" and "e," which we may write ê-e, or if greatly prolonged, ê-ê-ê-ê-e-e.

"I" seems to be composed of "a" as in "ah," and in various French words; followed by "e," as when called long "e." Thus, if we express "a," as in "ah," by "$\overset{F}{a}$," and use the common "e," we shall find "ī" to be "$\overset{F}{a}$e," or, when prolonged, $\overset{F}{a}$-$\overset{F}{a}$-$\overset{F}{a}$-$\overset{F}{a}$-e-e.

"O" they would form by a sound not used in English in its simple form, that of "ô" in the French word "dôme;" (a sound which does not seem to them identical with English "u" in "cut;") and to this they would add the sound of "oo:" "ō" would then be "ô-oo," or, if prolonged, ô-ô-ô-ô-oo-oo. It is believed to be impossible to elongate "ā," "ī," or "ū," as can be done with every simple vowel, without dwelling on one or other of the above initial or concluding sounds.

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY.

VOL. IX. JUNE—DECEMBER, 1862. No. 68.

Stated Meeting, June 20, 1862.

Present, nine members.

Prof. CRESSON, Vice-President, in the Chair.

A letter accepting membership was received from Dr. Englemann, dated St. Louis, Mo., May 29, 1862.

Letters were received from Dr. A. D. Bache and D. Huntingdon, respecting the deposit of a portrait of the former in the Hall of the Society.

A letter respecting the Michaux legacy was received from the President, Dr. Wood, dated Paris, May 12, 1862.

Dr. Bache read an extract from a letter, also from Dr. Wood, respecting the Tischendorff Manuscript.

Letters advising the Society of donations to the Library were received from the Royal Prussian Academy, dated Berlin, February 18th, 1862; the Minister of the Interior, dated Harlem, February 15th, 1862; the Royal Academy of San Fernando, at Madrid; and the Royal Academy at Lisbon, per the United States Legation, dated April 19th, 1862.

Donations for the Library were received from the Physico-Economical Society at Königsberg; the Academies at Berlin, Paris, Madrid, and Philadelphia; the Natural History Societies at Bonn and Boston; the Essex, Franklin, and Wil-

mington Institutes; the Minister of the Interior at Harlem; the Museum of Natural History, and the Geographical Society at Paris; the Royal, Royal Geographical, and Chemical Societies at London; the publishers of the Medical News of Philadelphia; Messrs. J. S. Morris of Baltimore; S. Shellabarger of Washington; F. Leypoldt of Philadelphia; Dr. Englemann of St. Louis; and the State of Wisconsin.

On recommendation of the special committee to which it was referred, Dr. Hayden's memoir on the Indian Tribes of the Missouri River was, on motion of Dr. Bache, ordered to be published in the Transactions.

The committee on Mr. Prettyman's communication, reported verbally through its Chairman, Prof. Cresson, that it had had an interview with Mr. Prettyman, who asked leave to withdraw his communication. On motion, leave was granted.

A suite of coal oil specimens was offered for the examination of the members present. Mr. Heber R. Clark, who was present, being invited to give a description of the coal oil localities with which he was most familiar, and from which he had himself collected the various oils which he exhibited, communicated very interesting and detailed information respecting their geological and statistical character.

Mr. Clark said that the principal part of the specimens, and commonly those of the lightest color, were from various borings around Edenburg, in Lawrence County, Pennsylvania, and in the same valley of the Mahoning, within the Ohio State line. Many were from the Slippery Rock Creek Valley. A number were from Oil Creek, and the neighborhood of Titusville in Northwestern Pennsylvania. One or two were from Mecca in Northeastern Ohio, and from Kentucky; the last being thick and black like tar.

The Edenburg "Continental Boring" was sent down through 80 feet of so-called drift; then through 200 feet of sandstones and shales, with a layer of black, fetid shale at the bottom, from which the gas blew off violently; then through 45 or 50 feet of the "First White Sandstone," with gas in its crevices (this sandrock is said to thin out eastward); then through 40 or 50 feet of shales and slates charged with gas and oil; then through 75 or 80 feet of the "Second White Sandstone," softer, coarser, and harder than the first, and full

of gas, to the oil stratum, 448 feet beneath the surface. The first sandrock has a soft middle member between hard top and bottom members.

Crawford's Boring at Edenburg struck oil (for the second time) in a supposed crevice leading up from the "Third White Sandstone," and at a depth of 580 feet.

Mr. Clark gave it as his experience, that the harder the rock was to drill, the lighter in color, purer in quality, and smaller in quantity was the oil; the softer the rock, the darker and more abundant the oil.

Mahoning Creek oil has a stronger smell than Oil Creek oil. The surface oil of Slippery Rock Creek is as fluid as water, and quite dark, running from and impregnating the surface of the ground and the rocks in place, and is collected in shallow wells.

At the Alban Well, 600 feet deep, on Oil Creek, six miles above its mouth, Mr. Clark saw the fresh oil spouting 100 feet into the air, a week after it had been struck.

At the Edenburg well first described, Mr. Clark noticed that for two or three weeks there occurred every day invariably a few minutes after eight o'clock P.M., a blow of gas, violent enough to stop the pump, and lasting from fifteen to thirty minutes, after which the gas seemed to be exhausted. He thinks that there is more gas blown off in winter than in summer, and that the testimony among the oil-well men is general to that effect.

The Librarian presented No. 67 of the Proceedings.

Pending nominations Nos. 456 to 465 were read.

The Society was adjourned.

Stated Meeting, July 18, 1862.

Three members present. No formal proceedings.

Stated Meeting, August 15, 1862.

Dr. Bache reported the following deaths of members:

Edward Stanley, an eminent surgeon of London, died May 24th, 1862, æt. 69.

Duke Bernard, of Saxe Weimar, æt. 70.

Dr. Bache presented a manuscript from the pen of our venerable fellow-member, Samuel Breck, entitled, "Recollections of my Acquaintance and Association with Deceased Members of the American Philosophical Society," which was referred to the Secretaries.

Pending nominations Nos. 456 to 465 were read.

And the Society was adjourned.

Stated Meeting, September 19, 1862.

Present, nine members.

Dr. Wood, President, in the Chair.

Letters were received from S. P. Berry, New York, August 23d, 1862, inviting members to attend the funeral of their late fellow-member, G. W. Bethune, and from Louise and Leopold M. and Heinrich Bronn, announcing the death of their husband and father, Dr. H. G. Bronn, a member of this Society, at Heidelberg.

Letters, accepting election, were received from Andrew Ramsay, London, July 1; J. A. Froude, Clinton Place, Hyde Park, June 22; A. W. Hofmann, London, Royal College of Chemistry, June 21; Dr. L. de Koninck, Liege, August 18, 1862.

Letters acknowledging donations in exchange, were received from the Batavian Society of Sciences, the Botanical Society of Canada, the Boston Public Library, the Connecticut Historical Society, the New York State Library, the Pennsylvania State Library, the Pennsylvania Historical Society, the Smithsonian Institution, and the United States National Observatory.

Letters announcing donations to the Library, were received from the R. Acad. at Lisbon, the R. Geog. Society at

London, the Batavian Academy, the Botanical Society of Canada, and the United States Coast Survey.

Donations for the Library were received from the Academies at Vienna, Batavia, Lisbon, and Philadelphia; the Societies at Königsberg, Bath, Kingston, and Boston; the Essex Institute; the Royal London and Dublin Societies; the Observatory at San Fernando; the Ecole des Mines; the Society of Arts, and the London Astronomical, Geographical, Geological, and Asiatic Societies; the American Antiquarian Society, and American Journal of Science; the Hartford Retreat; the Medical News, and Franklin Institute; College of Physicians, and Dr. Dorr, of Philadelphia; the Coast Survey, and Smithsonian Institution; Prof. Tafel, of St. Louis; the Santa Clara College, San Francisco; the State Library, and Board of Regents, at Albany; Prof. Volpicelli, of Rome, and Dr. A. D. Bache.

The deaths of the following members were announced: Dr. H. G. Bronn, at Heidelberg, July 5, 1862, aged 62; Hon. Samuel Breck, at Philadelphia, September 1, 1862, aged 91, announced by Dr. Franklin Bache. On motion of Prof. Cresson, Mr. Joshua Francis Fisher was appointed to prepare an obituary notice of the deceased.

Dr. Coates asked and received permission for the committee to append a note to Dr. Tafel's paper published in the Proceedings.

Prof. Cresson described the remarkable features of the rain-storm which flooded the streams in the neighborhood of this city on the morning of the 12th instant.

The peculiarities noted were the limited area affected and the unusually large quantity of rain-fall at particular points.

The quantity by measurement at the Gas Works, in the First Ward of the city, was $3\frac{6}{10}$ inches, at those in the Fifteenth Ward 6 inches, at the Gas-holder station, in the Twentieth Ward, 9 inches, and at a private mansion in the Twenty-second Ward 6 inches. These points are located on a triangle, whose sides are respectively about 5, 7, and 8 miles long; the First Ward station being at the southern apex, the Twentieth Ward at the northeasternmost angle, 7 miles distant, and the Twenty-second Ward gauge at the north-

western angle, 8 miles from the First Ward, and 5 miles from the Twentieth.

The Fifteenth Ward station is on the western side of the triangle, about 3 miles from the First Ward, 3 from the Twentieth, and 5 from the Twenty-second. Outside of a circle about 8 miles in radius, the centre of which was nearly 2 miles north of the Twentieth Ward station, at Ninth and Diamond Streets, the quantity of rain at this time does not appear to have been such as to produce any noticeable rise of the streams; but within these limits nearly all of the small streams, including the Tacony on the north and the Cohocksink on the south, were swollen beyond any freshet recorded concerning them.

Along the northern margin of the rain there was a remarkable development of electrical disturbance, by which much damage was done to several lines of telegraph wires and instruments.

Prof. Henry added instances to show that it was a general disturbance of the atmosphere, following the course and obeying the laws of the more continuous storms later in the season.

Prof. Lesley described a curtain aurora which he saw on the 23d of July last, near Sydney, Cape Breton.

The positive tone in which the possible nearness of auroral phenomena to the earth's surface is denied by some physicists, makes it desirable that every appearance to the contrary should be mentioned and placed on record. Professor Potter, in Art. IX, Phil. Mag., No. 158, page 51, reviewing a paper of De la Rive's in a preceding number, pronounces his own hypothesis,—"that the auroræ boreales are caused by the earth's electro-magnetism acting upon masses of very rare vapors, of like constituents to the meteoric stones and vaporous comets, moving in the planetary spaces under the laws of gravitation, and coming near the boundaries of our atmosphere" —"the only tenable one." The lowest calculated locality of an observed aurora, according to him, has been one given by Cavendish at fifty-two miles.

It seems unreasonable that the trigonometrical determinations of Halley, Cavendish, Bergman, Dalton, and others, should despotically exclude such observations as those recorded in No. XV of the Proceedings of the Literary and Philosophical Society of Liverpool, p. 104, where Dr. Walker, Sir William Hooker, and General Sabine testify that auroras are seen at so low a level that they interpose themselves

between the observer on the ship's deck and the low cliffs of the neighboring shore. This occurred to Dr. Walker in Bellot's Straits.

It was my good fortune to observe an aurora which, to my eyes, was embodied in and swept the earth with successive banks of Cape Breton fog.

It was in the evening of the 23d of July, 1862, on Little Glace Bay, which is one of several indentations in the eastern coast of the island, and about 17 (seventeen) miles, by road, from Sydney. The house in which Captain W. P. Parrot and myself were living was on the northwest side of the narrow bay, not far from its mouth. To the north and east spreads the Gulf of St. Lawrence. To the east by south stretches out the long headlands of Schooner Cove, with the Flint Islands opposite their end. During the five weeks which I spent in the neighborhood, my observations confirmed the account of the inhabitants that an almost perpetual fog-bank rests upon the southern coast and the headlands of Mirê Bay, Cow Bay, and Schooner Pond, enveloping the Scatari and Flint Islands, and sweeping obliquely across the gulf to the western shores of Newfoundland; while the indentation of the Glace Bay coast leaves it in the wake of the fog, so to speak, and therefore in sun and moonshine quite as constant.

Auroras are frequent, summer and winter, along this coast. Captain Parrot had seen them during March and April almost nightly; but they were of the common type, arched and waving, and radiant against the north, and not of any peculiar grandeur or brilliancy.

From the 1st to the 23d of July we noticed no aurora of any kind, although some of feeble light might have occurred. The weather was nearly always clear. I remember no local fog at Glace Bay; whereas I repeatedly admired the mountain-like barrier, resembling a sunlit Alpine country, stretched across the southeastern horizon, at a probable distance of from ten to twenty miles, and losing itself in a low perspective towards the distant shores of Newfoundland.

On the evening of the 23d an exclamation of my companion, who was sitting after tea so as to face the window, looking out towards the northeast, announced the phenomenon. Going round the house, we saw what I at once recognized from the plates of the French Expedition to Norway as a curtain aurora. It was totally unlike any aurora we had ever seen, and was evidently connected with a dense broadside of fog, which the south wind had just brought up from the south coast across the Little Glace Bay, and was driving from us northward. In this fog-bank hung, as it were, a brilliant curtain of

light with a wide fringe or flounce, of maximum brilliancy along its bottom edge, the light fading upwards along the curtain, but traceable to the very zenith; and the curtain stretching from the eastern horizon out at sea to the western horizon on the low hill tops. The perspective was perfect. The curtain was evidently vertical, thin, straight, long enough to reach from one limit of the vision to the other, and floating broadside before the south wind towards the north. No reasoning could convince us that these were not elements of the phenomenon, and moreover that the lower edge of the bright fringe was more than one or two hundred yards away, at its nearest point, when we first saw it. Its rate of departure from us was evidently that of the fog-bank, or that of the gentle south wind then blowing. The perspective of the whole curtain changed in conformity with that supposition. We had both spent our lives in topographical work, and no record of triangulations made upon this aurora would alter my convictions of the posture and movements of the beautiful object, derived from the natural triangulations of the unassisted eye.

But this was not all. The two most important features of the exhibition remain to be described.

In the first place the curtain hung not in a perfectly straight plane, but was magnificently waved or folded in recurrent plaits, like the gophered edge of an Elizabethan collar; and these folds were confined chiefly to the lower part of the curtain, or to the flounce of maximum brilliancy, although they sometimes went up high into the thinner body of the curtain. They were sufficiently recurved in some instances for us to see through *three thicknesses* of the flounce, the fold thus almost tripling its own light. But the perspective of each fold was unmistakable; and the impression on the mind was that of the unequal advance of the line of fog-bank, some sections pushing forward and swinging in front of intermediate sections which lagged behind. We saw no material break in the continuity of the light curtain; nor did there seem to be any fixed order of curve, the plaits sometimes lying one way and sometimes another; and therefore no impression of a vortical system was made, but rather of an irregular advance of the fog-bank. The plates of the French Expedition to Norway ("Lottin's Aurora Borealis," 8° and royal 4°), will give a better idea of the structure of the curtain than any description.

The most imposing part of the scene now followed. We had been watching the receding curtain perhaps five or ten minutes, and

it had reached a distance of apparently half a mile or a mile (it may have been more, however, as we had no means of accurate judgment), when we became aware of the passage over us of a second curtain, which soon occupied the place of the first, and went floating off after it towards the north; the interval between them apparently remaining constant, but the brilliancy and definiteness of the second being inferior to the first. And not long afterwards a third passed over us and followed in the rear of the other two, inferior also to the second. We gazed with astonishment and delight upon all three together, until they became an indistinctly defined common aurora in the north. Soon afterwards the clouds increased; the fog became denser; the light in the northern heavens was broken by bars and patches of black, and we retired into the house.

I am curious to learn whether in any part of the United States or Canada an aurora was seen on the evening named, and whether anything unusual was noticed in its appearance. But my belief is, that the phenomenon was modified to the folded curtain form in that particular locality, by reason of the peculiar parallel structure of the front part of the fog-bank which that night took possession of the surface of Cape Breton at its eastern end. Professor Stephen Alexander of Princeton informs me that this form of aurora was frequently seen by him on the coast of Labrador.

Prof. Henry described an aurora which he saw on the 4th of August last, at the Smithsonian Institution.

Prof. Bache referred to Mr. Espy's observations of auroras, by which he proved that the trigonometrical calculations or determinations of their heights by parallax were unreliable, and adduced instances to show that different observers do not behold the same phenomenon at the same moment.

Dr. Wood described the effects of lightning upon Dr. Wistar's house, north of Philadelphia.

Pending nominations Nos. 456 to 465 were read.

And the Society was adjourned.

Stated Meeting, October 3, 1862.

Present, thirteen members.

Judge SHARSWOOD, Vice-President, in the Chair.

A letter transmitting a donation for the Library was received from the Royal Academy at Madrid, dated January 1st, 1862.

Donations to the Library were received from the London Geographical, Geological, and Antiquarian Societies; Society of Arts and Institutions in Union; Dr. Edward Jarvis of Dorchester, Mass., and Prof. A. D. Bache.

Donations for the Cabinet were received from Prof. Bache, and Capt. Thomas Y. Field, U. S. Marine Corps.

The committee to which was referred the manuscripts of the late President of the Society, Peter C. Duponceau, presented by his granddaughter, reported, recommending that these manuscripts be carefully preserved in the Library of the Society.

Obituary notices of Professor Tucker and of G. W. Bethune, D.D., were read by Dr. Dunglison.

OBITUARY NOTICE OF PROF. GEORGE TUCKER.

Professor George Tucker was born in Bermuda in the year 1775. He came to this country when about twelve years of age, to be educated under the superintendence of his relative, Judge St. George Tucker, who was Professor of Law in the College of William and Mary in Virginia, and was the father of Judge Beverly Tucker, afterwards Professor of Law in the same college, and of Judge Henry St. George Tucker, Professor of Law in the University of Virginia, and author of Commentaries on the Laws of Virginia. Professor Tucker's collegiate education was at the College of William and Mary, after which he studied law, and practised his profession in Richmond, and afterwards at Pittsylvania and in Lynchburg, and for a considerable distance around, with great success. He was elected to the Legislature of Virginia from Pittsylvania, and in 1819, whilst a resident of Lynchburg, was chosen member of Congress to represent the district composed of the counties of Pittsylvania, Halifax, and Campbell. He was in Richmond at the time of the terrible sacrifice of life by the burning of the Theatre in 1811, and from a falling

beam, received a severe wound, which resulted in a permanent scar over one eye.

Whilst in Richmond, he contributed to the "British Spy," edited by Mr. Wirt, and wrote amongst other communications, in the year 1800, on the Conspiracy of the Slaves in Virginia, and in 1811, on the Roanoke Navigation, which were printed. In the State Legislature, and in Congress, he was most distinguished as chairman or member of important committees, in which his services were highly valued, and he was twice re-elected to Congress. In the year 1822, he published "Essays on various subjects of Taste, Morals, and National Policy, by a Citizen of Virginia," which were so favorably thought of, as was, indeed, his whole course in the Legislature of Virginia, and in Congress, by President Madison, that he urged and obtained his appointment to the Chair of Moral Philosophy and Political Economy in the nascent University of Virginia.

In the year 1819, after the death of a daughter at an early age, who had given promise of varied excellence, he wrote in Lynchburg, "Recollections of Eleanor Rosalie Tucker." In 1824 appeared "The Valley of Shenandoah," a novel, intended to illustrate the manners of the Old Dominion, which was republished, the writer has been informed, in London in 1825, and in Germany the year after.

In consequence of the protracted voyage—of fourteen weeks—from England of the vessel in which were the writer of this notice, and two of the professors, the opening of the University of Virginia, which was to have been on the 1st of February, did not take place until April, 1825, when Professor Tucker, the oldest of the professors, and the one most familiar with the habits of the country, was chosen Chairman of the Faculty for the first session.

During his residence at the University, he engaged in many literary labors. In 1827, he published a work of fiction entitled "A Voyage to the Moon," the evident aim of which was to fulfil for the existing age, what Swift had so successfully accomplished for that which had passed by; to attack, by the weapons of ridicule, those votaries of knowledge, who may have sought to avail themselves of the universal love of novelty amongst mankind to acquire celebrity, or who may have been misled by their own ill-regulated imaginations to obtrude upon the world their crude and imperfect theories and systems, to the manifest retardation of knowledge. It was reviewed by the writer in the American Quarterly Review for March, 1828.

In 1837, Professor Tucker published "The Laws of Wages, Profits, and Rent Investigated," and in the same year, his "Life of

Thomas Jefferson," in two large volumes, which received high commendation in the "Edinburgh Review" from Lord Brougham, as "a very valuable addition to the stock of our political and historical knowledge." In it, Professor Tucker does not always accord with the illustrious subject of his biography. The work, indeed, manifests a laudable desire to do justice, and to decide impartially on contested topics; and hence, perhaps, it failed to give satisfaction to the ardent supporters, as well as to the bitter opponents of Mr. Jefferson.

In December, 1837, he delivered before the Charlottesville Lyceum, "A Public Discourse on the Literature of the United States," which was published in the Southern Literary Messenger for February, 1838; and in which he enumerates many of the contributions made in this country to the domains of science and literature, concluding with glowing auguries of their future "progressive brightness."

In 1839 appeared a small volume, entitled "Theory of Money and Banks," the copyright of which Professor Tucker was unable to dispose of in Philadelphia or New York, and which was published in Boston, and soon passed to a second edition. His "Progress of the United States in Population and Wealth in Fifty Years, as exhibited by the Decennial Census from 1790 to 1840," was a valuable contribution to statistics and political economy. It was a thorough analysis of the census for the period mentioned, and led its author to important inferences on the subjects of the probabilities of life, the proportion between the sexes, emigration, the diversities between the two races which compose our population, the progress of slavery, and of productive industry, &c. To this he added an appendix in 1855, when eighty years of age, containing an abstract of the census of 1850, in the preface to which he expresses the patriotic hope "that these authentic exhibitions of our growth and improvement, so gratifying to the pride and love of country, will lead our citizens to greater party forbearance, and give them new incentives to cherish that Union to which, under heaven, they owe the blessings they enjoy." Impelled by the same sentiments, he gave "A Public Discourse on the Dangers most Threatening to the United States;" (Washington, 1843.)

Professor Tucker's last production at the University of Virginia, was a "Memoir of the Life and Character of Dr. John P. Emmet," the accomplished Professor of Chemistry and Materia Medica in the University, who died in 1842.

During the whole of this period of his life, he had been a prolific contributor to the public journals, and to the more imposing periodi-

cals, as the North American, the American Quarterly, the Southern, and the Democratic Reviews, and at an earlier period, to the Portfolio of Philadelphia; and when his colleague, Professor George Long, left the University of Virginia, to occupy a professorship in the University of London, and became editor of the London Journal of Education, and of the Penny Cyclopædia, Professor Tucker was, at his request, the author of various educational articles in the former, and in the latter, of sundry biographical notices, as of Presidents Jefferson and Madison, and of geographical contributions in regard to the United States.

From the first opening of the University of Virginia, it had been thought by many of its most intelligent friends, that it presented a favorable occasion for the establishment of a literary journal. It was presumed that eight or nine professors, who were daily occupied in communicating the fruits of their studies to others, would be qualified to make such a work at once useful and interesting to the public. It was known that the plan of the Institution was principally the work of Mr. Jefferson, and that important innovations had been made in its discipline and course of instruction, whence it was inferred that a lively curiosity would be felt to learn the progress of an experiment, made by one of the most popular and most philosophical statesmen of his age. It was not, however, until the year 1829, after the University had been visited by an endemic disease, from which no locality, however healthy, is exempt, and the feeling of the faculty, that if such a medium of communication had been in existence, they might have been able to allay popular apprehension, and prove from unquestionable evidence the general salubrity of the place, that they determined on the establishment of a weekly periodical, entitled "The Virginia Literary Museum, and Journal of Belles-Lettres, Arts, Sciences, &c.," the editorial charge of which was assigned to Professor Tucker and the writer. The first number appeared on the 17th of June, 1829; but although its contents were diversified and interesting, it was discontinued at the end of the year, and mainly for causes which have proved fatal to so many undertakings of the kind,—the failure of the contributors to afford the aid they had profusely promised, and hence the editors found, that to furnish the requisite materials from their own resources, demanded more of their time than was consistent with their other duties and engagements. The contributions of Professor Tucker were numerous and varied, but were, generally, popular essays on the subjects that appertained directly or indirectly to the chair he held in the University.

In the year 1845, at the age of seventy, with his mental powers undimmed, he resigned his Chair in the University of Virginia, and decided to spend the remainder of his days in comparative leisure. At all times fond of social intercourse with the enlightened, he had never failed to pass his vacations away from the University, and generally spent a portion of the time at the summer resorts of the refined and intellectual. Philadelphia was his choice for a permanent residence, both on account of its intelligence, and the opportunities afforded by its libraries to the seekers after knowledge. He was chosen a member of this Society in 1837, and was, likewise, a member of the Historical Society.

From the time Professor Tucker took up his residence in Philadelphia until his death, with brief intervals of relaxation, he adhered to his student life, and continued his contributions to various literary periodicals, and especially to those which were devoted to the elucidation of great questions of politics and political economy.

His undiminished intellectual activity is signally shown by his having commenced about the year 1850, or when seventy-five years of age, the herculean task of collecting materials for a political history of the United States. To aid him in the execution of his work, as he himself remarks, it had been his good fortune to have a personal knowledge of many, who bore a conspicuous part in the Revolution, and of nearly all those who were the principal actors in the political dramas which succeeded. The history extends to the elevation of General Harrison to the Presidency, in 1841. This seemed to Professor Tucker as far as he could prudently go, at least, without obtaining some testimony from public sentiment of his fairness to his contemporaries.

The work was comprised in four volumes, the first of which appeared in 1856, and the last in 1857. The first chapter is devoted to colonial history prior to the Declaration of Independence, and the remainder to the Confederation and the United States.

Nor was this elaborate work the last production of its venerable and indefatigable author. In 1859, he printed, and was his own publisher of "Political Economy for the People," being in substance a compendium of the lectures on Political Economy, delivered by him in the University of Virginia, with such alterations and additions as his farther experience and reflection had suggested; and lastly, in 1860, when eighty-five years of age, he issued on his own account, "Essays, Moral and Metaphysical," some of which had been already published anonymously or separately, but were now republished, and

added to the series. These essays were respectively, On our Belief of an External World; On Cause and Effect, read before this Society; On Simplicity in Ornament; On Sympathy; On the Association of Ideas; On Dreams; On Beauty; On Sublimity; On the Ludicrous; On Classical Education; On the Siamese Twins, read before this Society; and On the Love of Fame.

Professor Tucker's protracted and useful existence was now verging to a close. The death—in the summer of 1859—of his wife, the constant and faithful participator in his joys and his sorrows for upwards of thirty years, gave occasion to a thorough revolution in his domestic arrangements, and in place of wisely determining

> "To husband out life's taper at the close,
> And keep the flame from wasting by repose,"

he undertook extensive and harassing journeys. In the early portion of the summer of 1860, he visited Baltimore, Washington, Norfolk, the Eastern Shore of Virginia; and in the middle of June, in company with his son-in-law, Mr. George Rives, of Virginia, travelled as far as Chicago, to look after property which he had there. He did not suffer from the long journey he took on this occasion, and subsequently in Virginia, and returned to Philadelphia in the early part of the winter, with the intention of escaping the severity of the northern winter, from which he had suffered greatly the previous year, by a sojourn in the South. In December, he left Philadelphia, and in company with a friend proceeded from Richmond, in Virginia, to Columbia, in South Carolina; and afterwards to Charleston, Savannah, and other Southern cities. The last letter the writer received from him was dated Savannah, in February, 1861. In it he feelingly and deploringly depicts the condition of Southern sentiment as exhibited there. "The state of public affairs," he remarks, "is indeed gloomy, even to heart-sickening. People seem to be crazed in the fancies of imaginary evils, and of their strange remedies."

Some weeks after the date of this letter, the writer was pained to learn from Mrs. Rives, the eldest daughter of Professor Tucker, that while landing at Mobile from a steamboat from Montgomery, her father had been struck down by a bale of cotton, which was being removed from the vessel; and that the shock to his system was so great, that for two or three days he was insensible, or more or less incoherent. Under a most hospitable roof, he remained at Mobile, until his son-in-law reached the place, when he was removed to Sherwood, in Albemarle County, Virginia, the residence of Mr.

Rives, where, surrounded by his estimable relatives, he gradually sank, and died on the 10th of April, at the advanced age of eighty-six.

Few persons have contributed more to the literature of the period than Professor Tucker. He himself estimated the amount of his more fugitive productions,—about one-half of which were anonymous and gratuitous,—at ten thousand pages. His talents were at one period directed greatly towards the composition of works of fiction, and he occasionally wooed the muse. When at the White Sulphur Springs of Virginia, in his extensive journeyings in the summer before his death, he composed measured lines, upwards of one hundred in number, entitled "Life's Latest Pleasures," the manuscript of which he gave to the writer, before setting out on his last journey to the South, in which, to use his own language, he casts a look on the future,

> "And midst old age's cares and pains,
> Asks what enjoyment yet remains."

His forte was not, however, the imaginative. It is as a successful and equitable writer on great questions of politics and political economy, and of intellectual philosophy, that he will take his place. His Biography of Jefferson, and his History of the United States may, indeed, be regarded less as narratives of occurrences than views of great national and political questions, as they from time to time arose, logically discussed, and conveyed in language which has usually the merit of great terseness and perspicuity.

During his residence in Philadelphia, Professor Tucker was a frequent attendant on the meetings of this Society, and at the time of his death was a member of the Board of Officers and Council.

Obituary Notice of Dr. George W. Bethune.

Dr. George W. Bethune was born in New York on the 18th of March, 1805. The name Bethune was originally French, and was that of the celebrated Duc de Sully. Some of Dr. Bethune's ancestors must have migrated to Scotland, where the name was and is often pronounced with the accent on the first syllable, and from it were corrupted the names of the families of Beaton and Betton, who have the same heraldic bearings as Béthune, or Bethune' as it was pronounced by the family of the subject of this notice.

Dr. Bethune's parents were born in Scotland. His father, Mr. Divie Bethune, removed to New York in 1792, where he became a

successful merchant. His mother was the daughter of Isabella Graham, whose life was devoted to good works, and whose "Letters and Correspondence" were edited by her daughter. Both parents were celebrated in New York for their pious and charitable philanthropy.

After having passed three years in his preparatory education in Columbia College, in New York, the subject of this notice was sent to Dickinson College, at Carlisle, in Pennsylvania; and, after graduating there, entered the Theological Seminary at Princeton. In 1827 he was ordained to the ministry, and having, at an early age, married the excellent lady who survives him, he travelled for a time in the Southern States and in Cuba, officiating in Savannah; and, on his return, having joined the ministry of the Reformed Protestant Dutch Church, became, in 1828, the pastor of a prominent church at Rhinebeck, in New York, whence he was translated, two or three years afterwards, to Utica.

In all these places he was eminently successful in his holy calling; and soon gathered around him, to listen to his eloquent ministrations, and to enjoy his rare social and intellectual endowments, many of the wisest and the best.

He continued in Utica until the year 1834, when he was called to the pastoral charge of the First Reformed Dutch Church in Philadelphia. At once his admirable qualifications for his elevated office were appreciated; and measures were speedily taken to extend his sphere of usefulness, by the establishment of the Third Reformed Dutch Church, of which he was chosen pastor in the autumn of 1837. He continued there, respected and beloved by his congregation, and by all with whom he was brought in contact, until the fall of 1849, when he resigned his charge and removed to Brooklyn, in order that his wife, who had been for years grievously afflicted, might be nearer to one from whose medical services she was led to anticipate relief, an anticipation which unhappily proved to be illusive.

It was during his residence in Philadelphia that Dr. Bethune's reputation as a profound theologian, a faithful and devoted pastor, a learned and accomplished scholar, and an eloquent and gifted lecturer and author on various topics, became established. "Around him," as has been well remarked by his successor in the Philadelphia pastorate, the Rev. Dr. Taylor,* "were soon gathered many of the *élite* of the city, distinguished laymen and professional gentlemen.

* A Discourse on the Death of the late George W. Bethune, D.D., by William J. R. Taylor, D.D., &c., &c. Philadelphia, 1862.

Crowds of intelligent and admiring hearers thronged his services. Members of other denominations held pews or sittings in the church as well as in their own ecclesiastical houses. Strangers in the city in great numbers waited upon his ministry. He was known, admired, sought, welcomed, and honored among all denominations of Christians for his catholicity of principle, his faithful and eloquent preaching, and his services to every good cause in which Christians united, and to which he conscientiously trained his people. Few ministers have filled a wider sphere in the cause of general Christianity in our city, while none were more faithful to their own immediate theology and church."

Whilst his reputation was thus culminating in Philadelphia, he was energetically affording his powerful aid to every scheme for the promotion and diffusion of general literature and science, and for the good of his fellow-man. Early and prominent among these was the "Athenian Institute," the object of which was to establish a course of lectures, to be delivered gratuitously by literary gentlemen of Philadelphia, and which, for a time, was eminently successful. The first course was given in the winter of 1838, and the last in that of 1842. Large and intelligent audiences assembled together to listen to the diversified discourses, of which none were more popular than those of Dr. Bethune.

In the different reunions of the respectable members of the Board of Directors of the Institute, he was placed in intimate intercourse with the first literary and scientific gentlemen of the city, by whom his sterling qualities were at once appreciated, and his claims to be regarded as a true lover of wisdom cheerfully conceded.

It was not long before he was proposed as a member of this Society. He was elected in April, 1839, and, whilst he resided in Philadelphia, assisted, whenever he was able, in its proceedings.

After the meetings of the Society, a small band of five congenial spirits were in the habit of adjourning to each other's houses for the purpose of farther social communion; and for years these occasional unions of "*the five*" were maintained; until, indeed, the removal to other spheres of usefulness of two of its honored members, the lamented subject of this notice, and Professor A. D. Bache, and the subsequent death of two others, Dr. Robert M. Patterson and Judge Kane, left the writer solitary and alone, and dissolved one of the "most quiet, joyous, and instructive meetings," as it was happily designated by Judge Kane in his obituary notice of Dr. Robert M.

Patterson, read before this Society, that imagination could conceive or reality picture.

In these meetings none participated with more genuine and proper *abandon* than Dr. Bethune, and much of their geniality and instructiveness were ascribable to his beaming cordiality and richly stored intellect.

Amongst the earliest productions of his prolific pen, after his removal to Philadelphia, were those comprised in two volumes, which contain, in the language of one already cited, who well knew their value, "delightful, practical works, which will perpetuate his usefulness along with the best devotional writers of the century." "They exhibit," says Dr. Taylor, "to every reader some of the most remarkable traits of the public ministry of Dr. Bethune, embracing every variety of subject matter and style, from the most simple and severely Scriptural declarations of his 'Guide for the Inquiring,' through the gentle pages in which he deals with the bruised hearts of bereaved parents; and from the calm beauties and exquisite delineations of the 'Fruit of the Spirit,' up to the magnificent periods and resounding eloquence of his best pulpit efforts."

These volumes were respectively entitled: "The Fruit of the Spirit;" "The History of a Penitent, a Guide for the Inquiring;" and "Early Lost, Early Saved."

In the year 1846, Dr. Bethune published a volume of "Sermons," in accordance, as he remarks, with "the wishes of some friends," and "a selection made out of the discourses preached by him from his own pulpit, with some regard to variety, but principally to the practical character of their subjects." He modestly adds: "The prospect of their being widely read, when there are so many better books, is small; yet the attempt to serve the cause of our beloved Master is pleasant, and if He smiles upon it, it will be successful, not in the proportion of our talent but of His grace."

In 1847 he edited a new issue of a work of a very different character, which was undertaken as a pleasing relaxation from his severer studies, and executed at intervals, as he said, when others might have idled away their time. This was the "Complete Angler" of Isaac Walton, and the "Instructions" of Charles Cotton, with copious notes, for the most part original; a bibliographical preface, giving an account of fishing and fishing-books from the earliest antiquity to the time of Walton, and a notice of Cotton and his writings; to which he added "an appendix, including illustrative

ballads, music, papers on American fishing, and the most complete catalogue of books on angling, &c., ever printed."

For such an undertaking no one could have been better qualified and prepared. Fond of the sport to enthusiasm, perfectly acquainted with his authors, and possessed of an admirable piscatorial library, diligently accumulated at considerable expense, he brought to the subject an amount of familiar knowledge and opportunities for research possessed by few, if by any, in this country. The references, with rare exceptions, were verified by his own examination, whilst for the literary annotations he held himself alone responsible. Many of these, especially of a philological character, were the subjects of occasional playful but delightful and profitable correspondence between the writer of this notice and himself; and the whole work affords abundant evidence of rare learning and ample practical knowledge.

The annual return of the season of angling was ever looked forward to by him with joyous anticipations as a periodical relief from his constant and absorbing ecclesiastical studies and duties; and in the company of two or three kindred spirits and tried friends of himself and the rod, he hastened, at the proper season, to the rivers or lakes of this country or of Canada to enjoy his favorite pastime; and long will he be held in grateful remembrance by many of the rude children of the forest, who gathered together on the Sabbath to listen to his fervent and eloquent exhortations.

In an oration entitled, "A Plea for Study," delivered before the literary societies of Yale College, in 1845, he urges that, among outdoor recreations, none has been a greater favorite with studious men of Great Britain, because none is more suited to quiet habits, fondness for retirement, and love of nature, than angling,—not in the sea, but in brooks or rivers, where the genus *Salmo* abounds; and he cites from the catalogue of men illustrious in every department of knowledge, who have refreshed themselves for farther useful toil by this "gentle art,"—as its admirers delight to call it,—the name of Izaak Walton, "the pious biographer of pious men;" Dryden, Thomson, Wordsworth, among the poets; Paley, Wollaston, and Nowell, among the theologians; Henry Mackenzie, author of the "Man of Feeling;" Professor Wilson, the poet, scholar, and essayist; Sir Humphry Davy, the chemist, and author of "Salmonia;" Emerson, the geometrician; Rennie, the zoologist; and Chantry, the sculptor, to prove that the taste is not inconsistent with religion, genius, industry, or usefulness to mankind.

Dr. Bethune's fondness for the sport continued unabated to the last, and even when harassed during the summer of 1861, by the consequences of an attack of the malady, which ultimately proved fatal to him, he sighed for a brief return of his wonted enjoyment.

An excellent photograph was taken of him a few years ago, at the request of a small association of gentlemen in Brooklyn, in which he is represented in his habiliments of study, with his books of reference—as was his habit—distributed over the floor of his library, and the implements of his favorite sport hung around on the walls.

With a mind so eminently æsthetical, so appreciative of the sublime and the beautiful, it is not to be wondered at that Dr. Bethune should have wandered into the realms of poetry, and enriched its domain by many choice flowers.

From an early period he had given evidences of poetic taste, and in the year 1848 had incorporated many of his effusions into an elegant volume, entitled, "Lays of Love and Faith, with other Fugitive Poems." His object in publishing these is thus stated by him in a dedicatory sonnet.

> "As one arranges in a simple vase
> A little store of unpretending flowers,
> So gathered I some records of past hours,
> And trust them, gentle reader, to thy grace;
> Nor hope that in my pages thou wilt trace
> The brilliant proof of high poetic powers,
> But dear memorials of my happy days,
> When heaven shed blessings on my heart like showers,
> Clothing with beauty e'en the desert place;
> Till I, with thankful gladness in my looks,
> Turned me to God, sweet nature, loving friends,
> Christ's little children, well-worn ancient books,
> The charm of art, the rapture music sends,
> And sang away the grief that on man's lot attends."

Many of these lays were tributes of affection to those most dear to their author; whilst others were devotional, epigrammatic, patriotic, or miscellaneous; and all exhibit a rich and vivid imagination, much delicacy of sentiment and expression, and melody of versification.

In the same year he edited "The British Female Poets, with Biographical and Critical Notices." The specimens which he gives are well chosen, the biographical sketches ably written, and the characteristics of each writer skilfully discriminated.

Dr. Bethune's musical appreciation, too, was considerable; and

there were few ministers who paid so much attention to the important subject of church music.

During his residence in Philadelphia, he delivered various orations and occasional discourses, many of which were collected together in one volume, and published in New York in the year 1850. These were, "Genius," delivered before the Literary Societies of Union College, Schenectady; "True Glory," a sermon on the death of Stephen Van Rensselaer: "Leisure: its Uses and Abuses," before the New York Mercantile Library Association; "The Age of Pericles," before the Athenian Institute, of Philadelphia; Oration before the Literary Societies of the University of Pennsylvania; "The Prospects of Art in the United States," before the Artists' Fund, of Philadelphia; "Discourse on the Death of William H. Harrison, President of the United States;" "The Eloquence of the Pulpit," before the Porter Rhetorical Society of the Andover Theological Seminary; "The Duties of Educated Men," before the Literary Societies of Dickinson College; "The Duty of a Patriot; with allusions to the Life and Death of Andrew Jackson;" "A Plea for Study," before the Literary Societies of Yale College; and "The Claims of our Country upon the Literary Men," before the Phi Beta Kappa Society of Harvard University.

But satisfactory in all respects as were the various emanations from his polished pen, they were, perhaps, on the whole, less effective than his extemporaneous speeches, whether casual or prepared.

Always on such occasions self-possessed, his well-poised and forcibly expressed sentiments gushed forth in exuberance, with a frankness and fearlessness, and with a suitableness of action that told on his auditors, whether the topic concerned the sufferer from religious or political tyranny, the claims of African colonization, of which he was an ardent and staunch supporter, the promotion of charitable and literary associations and undertakings of all kinds, or the extension of discovery into remote and unexplored regions.

With so many claims to honorable distinction, it is not surprising that numerous philanthropic and literary associations should have hastened to enrol him amongst their members.

In the year 1849, for reasons before mentioned, Dr. Bethune removed to Brooklyn, and a short time afterwards was appointed pastor to the Middle Dutch Church there, which was soon merged in a fresh organization styled the "Church on the Heights." A new edifice was built for him, and a parsonage, both admirably arranged under his tasteful suggestions and immediate supervision, and in

such a manner that, by means of a simple acoustic arrangement, Mrs. Bethune, on her invalid couch, could hear the services of the church.

For ten years he continued his ministrations there to a large and increasing congregation, and during this time received the appointment to the Chancellorship of the University of New York, which he declined, unwilling to separate himself from the active exercise of his pastoral office. For a like reason he declined the Chaplaincy of the Military Academy at West Point; but did, for a short time, execute the duties of a Professorship of Pulpit Eloquence in the Theological Seminary at New Brunswick, which he visited weekly, until, indeed, his failing health compelled him to resign this along with his other elevated offices.

In his new sphere of action he was repeatedly called upon, as he had been in Philadelphia, to deliver discourses before learned bodies or popular assemblages; and he has doubtless left behind him many productions of his accomplished mind, which are worthy of being put into a permanent form. At one time, indeed, and not long before the first attack of the malady which arrested his expanded and expanding usefulness, he accepted so many invitations, and often in parts of the country so distant from each other, that the writer recommended to him a wise caution, and discouraged him from so much mental and physical labor as he was then incurring. An extract from a letter dated Brooklyn, in 1854, shows how largely his mind was then engrossed with this matter:

"The lectures which I have ready are what are called *popular*, that is, separate lectures on miscellaneous topics, for all the world like our quondam Athenian Institute lectures. Thus, I have one 'On Lectures and Lecturers' (an introductory), considering popular lectures and lecturers in an amusing, but, I hope, not unserviceable light. Another on 'Common Sense,' which, by the way, is long enough for two, a mixture of metaphysics and familiar illustration. A third on 'Work and Labor; the moral uses of the distinction between them,'—the best of my lectures. Another on 'The Orator of the Present Day,' originally a Phi Beta Kappa oration for Brown University, inquiring into the secrets of the orator's power, &c. Another on 'Oracles;' and another blocked, but not written, on 'Divination,' in both of which I strike at the spiritualisms (so called) of the present day, while I give illustrations of the subject itself. I shall try to write another during the winter, but am not sure what

on. Such are the lectures I have read, one or more in a season, here, in New York, New Haven, &c., &c."

Early in 1859 Dr. Bethune experienced the first serious attack of the disease which, in the end, was fatal to him. He was seized in the night with apoplectic stupor, from which he did not recover until the afternoon, when he awoke to full consciousness, his first playful question, on witnessing a regular and a homœopathic practitioner in the room, being, "Whether the north and the south pole had come together?" Luckily, there was no resulting paralysis. Still, his apprehensions of a recurrence, the danger of which was not concealed from him, whilst appropriate preventive measures were inculcated, induced him to abandon all his important and engrossing occupations, and to seek change and repose in a clime which had ever been his favorite, enriched as it is by those classic archaical associations, in which his cultivated mind, from his earliest manhood, had delighted to revel. Early in March he sailed with Mrs. Bethune in a bark for Naples, where, after a tedious but ordinary voyage, they arrived in safety and improved health. He did not succeed, however, in obtaining that quiet which he sought for. The perpetual political agitations in that city, and elsewhere in Italy, were, indeed, the source of much anxiety to him and to others, and tended to neutralize the good effects which might otherwise have accrued to him.

He returned to New York in the month of September, when his report to the writer was, that they had had a pleasant voyage over, and it had done them both much good; that he found no inconvenience except an undue excitability of nerves, which fault was becoming less and less. His attention had been directed to a church at Newburg, on the Hudson, and he had, moreover, immediately on his return, encouraging offers in New York, but had some desire to winter at the South.

During Dr. Bethune's absence in Europe, the office of Provost of the University of Pennsylvania had become vacant; and as he had resigned his pastoral office in Brooklyn, and was regarded by prominent members of the Board of Trustees as signally qualified for the office, he was written to on the subject by the writer of this notice; but before the letter reached Liverpool he had set sail for the United States. The writer hastened to New York to confer with Dr. Bethune on his arrival; and on his return wrote to the gentlemen who had nominated him to the Board of Trustees, expressing, in the

name of Dr. Bethune, the high sentiments he entertained towards the Board; his opinion of the great importance of the office, and his gratitude to Divine Providence that he should have been deemed fit for such a distinction; that had the appointment been given him immediately on his return to this country, he would have been strongly moved to accept it with pleasure, especially as it would have enabled him to resume his residence in Philadelphia, where he had spent fifteen of his happiest years, and where he had many friends very dear to his heart. But it could not be. His conscientious reluctance to leave the pulpit as his sphere of usefulness, had been increased by a call to a church in his native city, offering him strong inducements of every kind to accept it, and he had done so.

The self-denying liberality which had been extended to him by the excellent pastor of a church in New York, the Rev. Dr. Abraham Van Nest, Jr., and by a number of enlightened persons of different denominations there, could not well be resisted, and he wisely determined to remain in that ministry of which he was so distinguished an ornament. His nomination was consequently withdrawn.

For ten years, from September, 1839, to October, 1849, whilst a resident of Philadelphia, he had been an active member of the Board of Trustees of the University; and, in 1838, had received the degree of Doctor of Divinity—*causâ honoris*—at their hands.

During the year 1860, Dr. Bethune pursued tranquilly his dignified calling in association with his disinterested colleague, making no allusion, in his letters to the writer, to his former attack; observing, as he ever strove to do, the golden rule of moderation in all things; and hence avoiding, so far as he was able, all undue mental and physical excitement. In the November of that year he wrote:

"I am, thank God, very well. After my summer labors, kept up through August, I took one of my accustomed woodland jaunts, in consequence of which I flourished and flourish exceedingly. Mrs. Bethune, I feared, would not do well this coming winter, after the confinement and anxieties of her summer in town, and we projected a winter in the Bahamas; but she is now so much better that she does not wish to go. We are, in fact, through God's blessing, very prosperous, and I trust very thankful, which is the best happiness in this life. My ecclesiastical affairs go well. My admirable colleague is all I could wish, and more than I deserve." "We are about purchasing some acres on the Hudson, about a hundred and twenty miles from town, to make a nest for our old years. We are

not ambitious, but think that we shall be pecuniarily able to build a cottage large enough for us and the few dear friends who may visit us there. I propose to occupy myself this winter with writing a memoir of my mother, having just closed my care of her estate. Thus much for my egotism."

During this year he visited more than once his friends in Philadelphia, who rejoiced to observe the absence of all evidences of his former alarming seizure. He had the same characteristic geniality, the same social charms and intellectual radiance, but the expert and anxious observer was pained to notice a greater degree, perhaps, of nervous impressibility, and at times undue somnolency.

Sensible, however, as he was of the absolute necessity of avoiding all undue mental excitement, on the outbreak of the patriotic fervor which followed the fall of Sumter, he found it impossible to remain quiet; and although he had taken no part in the formation of the great meeting which was held in New York in April following, he was recognized in the street, pressed into service, and addressed the assembled multitude several times, and it is said "with tremendous energy and fire." He was a genuine, unalloyed patriot, the eloquent upholder of his country both at home and abroad. One of the most beautiful of the "songs" in his "Lays of Love and Faith," was composed years ago at midnight in an English mail coach.

"My country, oh! my country,
My heart still sighs for thee;
And many are the longing thoughts
I send across the sea.
My weary feet have wandered far,
And far they yet must roam;
But oh! whatever land I tread,
My heart is with my home.

"The fields of merry England
Are spreading round me wide,
The verdant vale and castled steep
In all their ancient pride;
But give to me my own wild land,
Beyond the salt sea's foam,
For there, amid her forests free,
My spirit is at home.

* * * * *

"There's no home like my own home
Across the dark blue sea;
The land of beauty and of worth,
The bright land of the free;

Where royal foot hath never trod,
Nor bigot forged a chain;
Oh! would that I were safely back
In that bright land again."

His national hymn, "God for our Native Land," the words and melody of which were composed by him in the last summer of his existence, breathes the same elevated patriotism, and has been widely disseminated in the hymn-books of the soldier.

It was with real apprehension that the writer heard of his friend's imprudent participation in the prevalent excitement; and it was not long before his sad forebodings became painfully realized. In one month afterwards (May 20th), he wrote to say that he had observed a sleepiness in his left hand and arm, and after a little while something of the kind in the leg of the same side, from the knee downwards, but much less than in the arm; and that he had called in his friend Dr. Hosack, of New York, under whose treatment he had improved, but was still not as well as he could wish. "My arm," he says, "is pretty much the same, though far from being useless. There seems to me, however, a slight paralysis. My head is clear, and I have no pain;" and he adds: "I have, of course, felt the excitement of these war times, and perhaps done more than I should."

He now moved up the Hudson to Catskill, where he had taken for the summer a most comfortable villa, beautifully situated on that charmingly romantic river, and immediately opposite the locality on which he had determined to build, and to pass the remainder of his days in blest retirement. His attention had become so alive to every morbid feeling and phenomenon, and his anxiety to understand his actual condition so great, that the writer hastened to visit him at Catskill. He had abandoned for the time all thoughts of building, and had been recommended to go abroad in the autumn for a more equable climate during the winter. The probable pathological condition of his brain, and the danger of its aggravation, were not concealed from him, but he was cautioned against the evils of brooding over it; and whilst temporary change of air, society, and scenery, were recommended, the writer did not withhold from him and his excellent wife his reluctance that so brilliant an intellect should be permitted to rust out; that he would rather see him continue "in harness," adding, that, whilst emotion of every kind ought to be avoided, no harm could be anticipated from the tranquil and normal exercise of the great organ of intellection.

A portion of the summer he spent at Long Branch, where he

found, to use his own language, "pleasant air, pleasant people, and not unpleasant quarters." He described himself as, on the whole, better, but still "had no courage for work, and was much worried over the troubles of the country." "I feel strongly inclined," he says, "to escape for a while to some distant spot, where I can live cheaply, in a milder climate. You say that I must avoid excitement. I cannot preach without emotions, and those of the strongest, often the most agitating, kind."

A few weeks afterwards he announced that Mrs. Bethune and himself had made up their minds to go abroad again; that her own comfort required a milder climate than he could give her in the United States; and that, among other reasons, he found the endeavor to avoid emotion in the pulpit killed his manner, and unfitted him for the control which his constitutional energy had hitherto given him over an audience.

Towards the end of September, he paid the writer a brief visit, to take leave of him and other friends in Philadelphia; and although there were few signs of impaired physical powers, and none of mental decadency, the writer could not help dreading a recurrence of his most dangerous malady, and fearing that they might never meet again.

Early in October Dr. Bethune sailed, for the last time, from his native city. The voyage, which was in a screw steamer, was safe and quick, but not very comfortable, owing to the rolling of the vessel, which, he said, shook them more than any paddle-wheel boat he had ever tried. The writer was pleased, however, to learn from him when within a few hours from Queenstown, Ireland, that he was, to all seeming, perfectly well, with not a trace of paralytic influence, and all his corporeal functions going on right. "I only fear," he adds, "being *too* well, but try to take care of myself. We have on board besides the ship's surgeon—an intellectual Scotchman, a Dr. Black—Dr. Haslett of the United States Navy, a personal friend of mine, so that I shall not want for doctors."

It had been Dr. Bethune's intention to visit the Channel Islands, and thence to pass to Pau or to Bagnères de Bigorre to spend the autumn, to linger some little time among the Pyrenees, and then to proceed to Florence to winter; and his plans were carried out with but little variation, except as to time. He spent nearly three weeks very agreeably in Guernsey, which he found to be an economical place, and with a good climate. "It would serve," he says, "as a capital place of retirement for a party of people sufficiently large to

make a little society of their own,—the better sort being not a little reserved to strangers." He wrote thus from Tours, in France, which he did not reach until near the end of November, and left immediately for Bagnères, where he arrived after a journey of much fatigue, particularly to Mrs. Bethune. Here he tarried for upwards of two months, pleased with the climate generally, and with the agreeable society he met with.

His health was good during the early portion of his sojourn at Bagnères; but, subsequently, damp, chilly weather deprived him of his usual walks, whilst the rumors of war with England, and some other troubles, disturbed him not a little. He afterwards suffered so much from neuralgic headaches, which had previously annoyed him, as well as from boils, and from threatenings of his more serious malady, that he deemed it wise to consult an old practitioner of the place, under whose treatment he improved.

"I do not see," he says, "in what to blame myself for having caused this attack. I have lived very moderately, and taken a good deal of exercise, on foot and in the saddle. I had also been much relieved of my anxiety by recent letters."

His last letter to the writer was from Florence, and was dated April 18th, only a short time before his decease. Its tone was cheerful, and even sportive. He spoke of his boils as having become "beautifully less," until they had disappeared altogether, for which he felt rather sorry, as he thought "they might serve to draw off attention from his head;" that he had not had any ill turn since his previous letter, and had been very comfortable in most respects.

The long land journey from Bagnères to Florence, beautiful and picturesque as it is, was exceedingly trying, to Mrs. Bethune more especially. The voyage by steamer she had to forego, in consequence of the difficulty of getting on board. The journey occupied about a month, and they did not reach their destination until the 15th of March. Here he designed to rest for a couple of months, and then proceed for the summer to the Baths of Lucca, which have the reputation of being in the coolest quarter of Tuscany. Of the climate and society of Florence he remarks: "As for the climate, what can you say of any climate in April? When the sun shines, it is delicious; when it rains, or there is snow on the Apennines, it is trying to the nerves. However, I have liked it on the whole. Madame does not, although I hope the summer will make it more pleasing in her eyes. Though the prices of things have increased, the charms of Florence have not been diminished. The same treasures of art,

the same loveliness of surrounding scenery and geniality of climate attract the voyager from all parts of the world, giving the resident from abroad an excellent society of whatever character he prefers; so that I know no place more eligible for a sojourn or a more protracted stay. There are, just now, so many pleasant American people here, that, with the addition of a few Scotch and English, my visiting list is a little too large for convenience. We have, also, valuable and extensive libraries and collections; but, having been hunting for apartments nearly all the while, I have little time for study. I was very tranquil (so far as news about our country throughout the Trent excitement would allow me to be) at Bagnères. I am more interested and amused here. I brooded too much at Bagnères. I am more active at Florence." He adds that he had not experienced any disagreeable symptoms of late, but could not entirely suppress the apprehensiveness so natural to one in his physical condition.

Nine days after penning those lines he was no more. He died, at the mature age of fifty-seven, in the place which, in the language of his estimable wife, "he thought the most beautiful on God's earth." On the last evening of his life, while watching the setting sun from the window of her chamber, he said: "Oh, Mary, how I wish you loved Florence as I do. It is beautiful to live in, and pleasant to die in." To which she replied: "I do love Florence, and hope God will spare us many years to love and serve Him here."

It was much against her will that he preached on the following morning; for she had noticed a restlessness in his eye and manner which, ever watchful and apprehensive as she was, she did not like; and was much relieved when, after the service, she heard his cheerful voice in the adjoining apartment. He begged of her not to scold him for having been preaching extemporaneously. She looked up sorrowfully, and said: "How could you? You must be tired." He answered, "A little," and added: "I will bring Dr. Haslett to you when I have done with him."

From a letter with which the writer was favored by Dr. Haslett it appears, that no sooner were the services of the church ended than Dr. Bethune turned to him and said, in a somewhat anxious manner, "I wish to speak with you." Dr. Haslett accompanied him home, but could not detect any symptoms of cerebral affection, other than the anxious manner, which might, he thought, be attributed to his ever present dread of its recurrence. It was not long, however, before too manifest indications of fully formed apoplexy supervened;

and near midnight, "in an effort to change him to a more comfortable position," says Dr. Haslett, "his head dropped, one spasmodic struggle, and all was over."

Such is an inadequate notice of an accomplished member, whose loss this Society, in company with the world of letters, deplores, and whose merits it has determined to hold in *memoriâ*.

Intus et in cute the writer knew him, ardently did he admire him, and most cordially can he adopt the sentiments, so well and so concisely expressed in a touching and eloquent "Tribute" to his memory, by a friend and colleague in the pastorate, the Rev. Alexander R. Thompson,* of New York, who equally knew and revered him.

"God does not often suffer us to look on such a man, in whom centre at once such qualities of heart and head, and in such exquisite balance. Born in the faith of Jesus, of pious ancestors; nurtured in the truth and love of the Gospel; early consecrated; early called to the service of the sanctuary; with the clear head of a logician; thoroughly skilled in the dialectics of the schools; enjoying every advantage of culture; with an exquisite taste, and a keen eye for the beautiful; with wit that could strike like chain-lightning, or that could sparkle like a star; admiring scholar of the great and good of all time; adept in the languages of the ancients and of the moderns; drawing to himself the friendship of men of eminence and worth, and recognized by them as among his peers; a poet born; a giant in forensic effort; a Christian gentleman; a man in energy and power, with the love of a woman, with the heart of a child; consecrating everything that God had given him to the Savior of his love; an incomparable preacher, who could play on the heartstrings of little children; generous and genial; a lover of nature; true to the interests of the church at whose altars he ministered, but a lover of good men of every name; with whom patriotism was a passion, and whose love for the land of his birth was rooted in his very life; who, for nearly forty years, preached, not himself but Christ Jesus the Lord, with eloquence and power and characteristic success. We may thank God that he ever gave us such a man. His life is his testimony."

The remains of Dr. Bethune, in accordance with one of his last requests, were brought to New York; and, on the 3d of September, were buried with unusual honors in the cemetery of Greenwood, by the side of the mother whom he loved so well.

* A Tribute to the Memory of the Rev. George W. Bethune, D.D., &c., &c. New York, 1862.

A communication for the Transactions was presented by the Secretary, entitled "Intellectual Symbolism," by Pliny Chase, of Philadelphia, which was on motion referred to a committee, consisting of Dr. Goodwin, Rev. Mr. Barnes, and Professor Coppée.

Professor Bache described a model, which he presented to the Society, as the ingenious workmanship of Mr. Engle in the office of the United States Coast Survey. "The surface of the plaster model was designed to illustrate the diurnal variation of the magnetic declination, and its annual irregularity, as found in the discussion of the magnetic observations at Girard College, Philadelphia, 1840 to 1845, Part II. It is intended to make similar models for the horizontal and vertical forces."

Dr. Franklin Bache made some remarks on the discovery of the new metal thallium.

Dr. Harris exhibited the skull of the Buceros scutatus, or Helmet Hornbill of India, upon the frontal plate of which had been carved a beautiful Chinese intaglio by an artist in Canton. The specimen presented was obtained from the male bird, the head of which is of the same character with, but larger than that of the female, presenting a larger frontal space, and therefore more highly valued. The bird is a species of raven, quite common in India. It is not at all well proportioned, having a large head, thick neck, long body and tail, and somewhat short legs. Its neck is bare of plumage, and its head also, except at the occiput. Its prevailing color is black. Like the other Buceri, it presents a large protuberance on the top of its head, which is hollow, and has no connection with the cranial cavity. This eminence presents none of the characteristic features of bone, and is remarkable for the extreme thickness of its frontal plate and its ivory-like formation. It is of a light nankeen-yellow color.

A few years ago it was discovered in China that the skull of this bird might be used for ornamental purposes, and plates of it carved to represent flowers, and then rendered translucent by some chemical process, were set as breastpins and bracelets and sold to a few foreign residents in Canton. Some of these articles were sent out to this country, and were shown by Dr. Harris to several members of this Society and of the Academy of Natural Sciences, all of whom doubted the correctness of the Chinese statement that they were made from portions of a bird's head, and one, without any hesitation, pronounced

it a deception, and said that he knew of no bird in the collection of the Academy of Natural Sciences upon whose head such carvings could be executed. To satisfy these gentlemen of the correctness of his statement, Dr. Harris sent an order to the artist in Canton, and, after waiting about a year and a half, had the pleasure of receiving the skull carved as here exhibited, a convincing proof that the Chinese are sometimes honest in their representations, and do even at the present day make new discoveries. So rare are these carvings, that very few of our residents in China have ever seen them, or even know of their existence, and it is believed that but two or three persons in America have as yet come into possession of the jewelry made from them. The skull, as exhibited, is no doubt the only specimen of the kind in existence, and shows the character of the material of which the carvings are made, as no clarifying process has been used to change its natural appearance.

Whether any other of the Buceri have ivory-like plates of the same character and equal thickness, Dr. Harris is unable to state. Some of them have very large and peculiarly shaped yellow-colored protuberances on their heads; but many of these are quite thin. In others the "horn," as it is called, is exceedingly light, and composed of true bone, covered with a thin, horny plate, as in the Buceros buccinator. The Helmet Hornbill, it is believed, is not found in China, but is imported from India, Americans long resident in the former country having never seen it. It may possibly exist in the southernmost part of the empire, or may migrate thither in the hot season.

The material of which this carving is made is very brittle, and can only be cut during the damp, rainy season. It is no doubt this fragility which has caused the artist to toughen them by chemical clarification, in order to preserve them when worn as ornaments.

Pending nominations Nos. 456 to 465 were read.

Judge King offered the following resolution, which was unanimously adopted: That the Vice-President of the Society now presiding, the Hon. George Sharswood, be authorized to represent the Society to sign and execute all the powers and procurations necessary to preserve and obtain the legacy given to the Society by André François Michaux, and to constitute Mon. Germain, notary at Pontoise, the agent and attorney of the Society for that purpose.

And the Society was adjourned.

Stated Meeting, October 17, 1862.

Present, sixteen members.

Professor CRESSON, Vice-President, in the Chair.

Donations for the Library were received from the Boston Natural History Society, the publishers and editors of the American Journals of Science and of the Medical Sciences, the Smithsonian Institution, Mr. Jules Marcou, and Dr. Roehrig.

A letter was read from Mr. Samuel Powel, dated Bethlehem, Pa., October 15th, 1862, accompanying and describing specimens of iron manufactured from the slag obtained from the Zinc Works of the New Jersey Zinc Company, through one of its members, Captain James Jenkins, of Elizabeth City. Remarks upon this ore and its locality, and the history of its use were made by Professor Trego, Dr. Hays, and Professor Lesley.

In Sussex County, New Jersey, are the mines of Franklinite ore, from which the products are derived. In the process of manufacturing oxyd of zinc, there remains a scoria which is rich in iron. From the treatment of this scoria in the blast furnace arises the iron which I send you.

In the first place there is a specimen of black, porous, spongy-looking pig iron. This is the product of first blowing in the furnace with charcoal. Although so different from the white, lustrous, and largely crystalline specimen which accompanies it (which is the next product of the same furnace and ore (scoria), when it comes into full blast with anthracite), the black, spongy ore *behaves* in the same peculiar way which characterizes the white pig, when it is attempted to be made into castings by any process.

The uniform character of the castings made from either of these pig metals is as follows: they are hard, white, and brittle, and largely crystalline. Also, where the furnace has an overcharge of ore, it will produce a No. 2 pig, which is very light gray, and finely granulated, but which will still make the same sort of castings. The appearance of the white pig is so remarkable, that I think few people conversant with pig iron would guess it to be iron. I do not believe

that its peculiarity depends upon the presence of zinc, but I suspect it contains manganese. These irons would then seem totally unfit for ordinary castings, for even when mixed with other pig iron, it is impossible to work them for castings. On one occasion, in attempting to make a roll in this way, which was afterwards broken, the white iron had disposed itself about the surface, and it was then attempted to repeat the experiment, but no such disposition of the hard iron could again be obtained.

For the purpose of being worked as malleable cast iron, its first remarkable and valuable properties begin to appear. I send you two fragments of a cast iron stirrup made in this way. It is hard and strong when cold like steel. The larger piece has been in one place drawn out, hardened, tempered, ground, and sharpened as a knife-blade, which has quite a good edge. Thus you see it is malleable, and is in fact *a steel.* The other and smaller fragment of the same cast iron stirrup is welded to a small piece of a nail-rod. Thus it has all the requisites for the best quality of malleable cast iron work, with the peculiar steel-like character, only it is not capable of bending when cold as malleable iron.

The small, square cake of coarse-looking iron, is a piece of the common puddled bar made from the white cast iron. It appears here as already a good quality of iron in the first stage of refining.

Next I send you a loop of round bar iron, about one and a half inch round iron, which has been, I should think, nine inches long. Captain Jenkins saw this specimen bent in the form you see it *entirely cold.* The two ends are in contact, and the opening in the centre of the loop is about five-eighths of an inch. It is impossible to find a more remarkable evidence of the toughness of a specimen of wrought iron in the cold. The outer curve of the bend is perfectly unblemished. The cut and fractured ends speak for themselves.

Next I send you a sample of octagon cast steel, which was made from the puddled bar iron in black lead crucibles. This was done at Sufferns or Ramapo, New Jersey. I send you also, through the kindness of the Captain, the formula for the steel charge in black lead crucible, viz.:

40 pounds of iron.
½ oz. yellow prussiate of potash.
1 oz. sal ammoniac.
8 oz. charcoal.
1 gill of salt.
3½ oz. manganese.

I send you also the analysis of the white pig of the New Jersey Zinc Company.

Iron,	88.30
Carbon, chemically combined,	5.48
Carbon, free or graphite,	0.00
Silicum (sic),	0.20
Manganese,	4 50
Sulphur,	0.08
Phosphorus,	0.15
Zinc,	0.30
Loss,	0.99
	100.00

This curious iron has become in my eyes still more important, since I found a recent notice of Mr. Krupp, of Essen in Prussia, who has sent to the London Exhibition some important productions of his wonderful steel works, such as huge ordnance, shafting, &c. The notice of Krupp states, that his steel is produced from a German ore of zinc and iron, and it, doubtless, therefore must resemble this Franklinite of New Jersey. I need make no remark in this connection, to convince you of the immense importance of a production which may possibly enable America to enjoy the advantages of such manufactures as those of the Essen Works, which are now without a rival in the world.

I may add that the malleable iron stirrup was made by Messrs. Bruen, by the same process and side by side with other castings made of the usual Sterling white iron. The Sterling iron made cold, tough, malleable castings, and *our* new iron made them all like the stirrup. For these malleable articles, the pig iron is first melted in an air furnace on the hearth, and cast into plates, which are broken up and re-melted in a cupola for casting.

Another remarkable, and I believe, unique property of the white pig iron, has been made the subject of a patent. The pig iron, when coarsely pulverized, and sprinkled upon a bar of wrought iron, heated quite red, or approaching white, melts, forms a union with the surface, *and flows entirely over it*, producing a sort of case-hardened enamel, which resists the edge of tools.

It occurs to me that this property might be of use in uniting such enamelled surfaces to cast iron, poured upon them in the mould, or for various other purposes.

Dr. Emerson referred to a pamphlet recently published by

him, concerning the culture of cotton in the Middle States; and mentioned the fact, that the growth of cotton in Maryland, Virginia, and Delaware is no new thing, it having been raised there to a limited extent since 1786. Dr. Emerson remarked, that he himself had this season raised cotton from the seed in Kent County, Delaware, planted May 5th, and he presented to the Society some specimens from his crop. He believes that the culture of cotton in Northern localities may be more successfully attempted than formerly, on account of the use which may now be made of concentrated fertilizers, such as superphosphate of lime, &c. Dr. Emerson added, that potash had been recently obtained by separation from the other ingredients, in the greensand marls of New Jersey, at a cost of four and a half cents per pound for the potash.

A letter was read describing an accompanying specimen of jasper, from the lately discovered cave in New Hampshire, whence the Indians of New England are supposed to have obtained their arrow-heads and flint instruments. The cave is an artificial excavation, twenty-eight feet long, twelve wide, and eight or ten high, with a narrow mouth in a jasper vein, inclosed in the "granite" of a steep mountain spur, on the banks of the Androscoggin, one and half miles from Berlin Falls.

Pending nominations Nos. 456 to 465 were read, and there being no further business before the meeting, the Society proceeded to ballot for candidates for membership, after which, the following named gentlemen were declared by the presiding officer to be duly elected.

Dr. Evan Pugh, Principal of the Farmers' H. S., Penna.
Dr. A. A. Henderson, U. S. N.
Robert Cornelius, of Philadelphia.
Dr. Prof. Rudolph Virchow, of Berlin.
Dr. Prof. Fred. Theo. Frerichs, of Berlin.
Thomas Jefferson Lee, T. E. U. S.
Dr. Prof. Louis Stromeyer, of Hanover.
Dr. Prof. Karl Rokitansky, of Vienna.
Henry Winsor, of Philadelphia.

And the Society was adjourned.

Stated Meeting, November 7, 1862.

Present, seven members.

Dr. Wood, President, in the Chair.

Letters accepting membership were received from P. Volpicelli, dated Rome, October 4th, 1862; J. Lothrop Motley, dated Vienna, October 13th; Robert Cornelius, dated Philadelphia, November 4th; Evan Pugh, dated Agricultural College, Centre County, Pa., Nov. 4th, 1862.

Letters acknowledging receipt of the publications of the Society were received from the American Antiquarian Society; the New Jersey Historical Society, dated October 3d and November 6th; the Historical Society of Pennsylvania, dated October 23d; the Pennsylvania State Library, dated October 31st, 1862; the Royal Academy at Brussels, dated November, 1860.

Letters regarding donations for the Library were received from J. E. Cohen, M.D., Baltimore, October 23d; C. F. Loosey, New York, October 22d; United States Treasury Department, October 18th; the Zool. Bot. Society, March 20th; and Imperial Academy, August 1st, at Vienna; and from the Natural History Society at Riga, dated April 10th, 1862.

Donations for the Library were received from the French Minister of Public Works; the Royal Cornwall Polytechnic Society, at Falmouth; the Royal Academy and Royal Observatory, at Brussels; the Imperial Academy, the Royal Geological Institute, and the Zoologico-Botanical Society at Vienna; the Trustees of the New York State Library; T. W. Reeve, of New York; Blanchard & Lea, of Philadelphia; and Evan Pugh, of Centre County, Pa.

The death of General O. McKnight Mitchell, at Hilton Head in South Carolina, October, 1862, aged 52, was announced by the Secretary, and on motion of Dr. Hays, Prof. Kendall was appointed to prepare an obituary notice of the deceased.

Mr. Lesley described a section of coal-measure rocks made by him during a visit to the neighborhood of Sydney, C. B., and noticed other remarkable features of the British Provinces.

Section of Coal-measures on the Cape Breton Coast.

By J. P. Lesley.

			ft.		
	(a.)	Soft shales with a hard belt at the bottom,	20.0		
Red belt, 27 feet,		Red and green alternations,	10.0		
		Red,	10.0		
		Green,	2.0		
		Red,	1.6		
		Green,	.6		
		Red,	1.6		
		Green,	1.6		
Iron,	(b.)	Fire-clay with nodules of iron,	5.0	Mud rocks,	85½
		Fire-clay, compact, sandy,	2.0		
		Fire-clay, pure,	5.0		
		Red shale,	2.0		
		Fire-clay,	2 0		
Iron,	(c.)	Iron ore, continuous,	.6		
		Shales,	12.0		
	(d.)	A black streak.			
Iron,		Shales, layers of small nodules of iron,	8.0		
	(d.)	A black streak.			
		Fire-clay,	2.0		
		A black streak.			
		Sandstone cliffs,	8.0		
		Sandy top shales,	6.0	Sand rocks,	23 0
Coal,		Coal, good,	1.0		
		Fire-clay running into sandstone,	6.0		
Coal,		Black slate, genuine,	2.0		
		Fire-clay,	8.0		
	(e.)	Slate cliffs,	40.0		
Coal, "Hub vein," 8 feet,	(f.)	Slate,	1.6	Mud rocks,	58.0
		Soft coal,	1.6		
		Solid coal,	4.0		
		Hard coal,	1.0		
	(g.)	Great sand rock, full of plants,	20.0	Sand rocks,	20 0
Coal,	(h.)	Cannel coal-bed,	1.6		
		Fire clay,	6.0		
		Cannel coal,	.0½	Mud rocks,	10.0
		Fire-clay,	2.6		

		Sandstone,	2.0		
		Flaggy cliff rock,	6.0		
		Sandy slates, becomes dark banded slate rocks,	11.0	Sand rocks,	25
Coal,	(i.)	Cannel coal,	.1		
	(i.)	Underclay,	3.0		
		Sandy clay,	3.0		
		Shaly clay,	6.0		
		Pure clay and fine yellow slate,	4.0		
		Shale,	.6		
		Blackish clay shales,	8.0	Mud rocks,	45.0
		Soft clay shales,	2.0		
Iron,		Iron ore, balls, thin plate,	.8		
		Sandy shales,	6.0		
		Soft clay shales,	3.6		
		Dark soft clay cliffs,	1.3		
		Soft shales,	7.0		
		Sandstone shales,	2.0		
		Shales, gray,	5.0		
		Blackish shales,	1.0		
		Shales, gray	6.0		
		Massive, flaky shales,	2.0		
		Sandy, flaky clay,	9.0		
		Shale cliffs, sandy,	11.0	Sand-mud rocks,	92.0
		Blackish shales,	10.0		
		Sandy shale cliffs,	5.0		
		Sandy shales,	20.0		
		Clay, becoming at bottom sandstone, over which	21.0		
	(k.)	Seam of coal,	.0½		
Coal,	(k.)	Top slate,	6.0		
	(k.)	Coal, 2 in. in black slate,	.6		
	(k.)	Under clay shale,	5.0		
		Blackish soft shales,	4.0		
		Gray shales,	2.0		
Iron,		Iron ore, poor, sandy,	.6		
		Gray shales,	4.0	Sand-mud rocks,	69.6
		Sandstone, flinty,	1.0		
		Fire-clay, compact below,	6.0		

		Sandy shales,	6.0	Sand-mud rocks,	69.6
		Yellow shales,	6.0		
		Gray, blackish shales,	6.0		
		Gray shales, soft, sandy,	12.0		
	(l.)	Soft shales (local),	5.0		
	(m.)	Sandstone, false bedded shales, soft at bottom,	17.0		
		Clay,	.3		
Coal,	(n.)	Cannel coal,	.1		
		Soft, yellow, concret. clay, clay slates,	7.0	Mud rocks,	31.5
		Harder shale,	1.0		
		Gray shales,	2.6		
Iron,		Iron nodules.			
		Gray shales,	4.0		
		Soft, blackish shales,	.2½		
		Sandy shales, foliated,	3.0		
		Top clay	1.0		
		Gray blackish shales,	.6		
Coal,		Coal slate ("Cannel"),	.6		
		Hard, sandy shale,	.8		
		Coaly matter,	.½		
		Hard, sandy shales,	3.0		
		Compact fire-clay,	8.0		

These are the lowest rocks seen before coming to the south of Little Glace Bay. A slight break in the section takes place here.

	Soft measures,	10.0	Mud rocks,	16.0
Coal,	Coaly top slate,	.4		
	Coal, bituminous,	.3		
	Sand-rock, variable,	1.0		
	Green clay, including horses of sandrock,	.6		
	Fire-clay,	2.0		
	Compacter clay,	2.0		
	Harder sandy clay, Sandstone ledge,	2.0	Sand rocks,	9.0
	Compact sandstone, with thin flag courses,	7.0		
	Fire-clay shale,	3.0	Mud-sand rocks,	35.6
	Fire-clay, pencil shale,	4.0		

	(o.)	Shale sandstone,	3.6	Mud-sand rocks,	35.6
		Fire-clay, pencil shale,	6.0		
		Sandy shale,	15.0		
		Crumbling shale,	4.0		
		Sandstone,	8.0	Sand rocks,	43.6
		Blackish shales and fire-clay,	4.0		
		Sandstone, massive,	10.0		
		Sandy fire-clay, thin,	2.0		
		Shaly sandstone, with 6 inch flag courses,	7.6		
		Shales (dark outside),	7.6		
		Sandstones, flaggy,	3.0		
		Gray top shales,	1.6		
Coal,		Black bituminous slates,	.5		
		Cannel coal,	.1		
		Black bituminous slates,	.6		
		Fire-clay shales,	1.0		
		Shaly sandstone,	1.0		
	(p.)	Sandstone,	2.0	Sand rocks,	15.6
		Sandy shale,	11.0		
		Fire-clay,	5.0		
Coal,		"Harbor vein,"	5.0	Mud rocks,	30.6
		Shales, foliated,	8.0		
Iron,		Iron ore, plate breaking into balls,	.3		
Coal,	(q.)	Coal, with a centre streak of jet,	.8		
		Shales, red, green, yellow,	7.6		
		Hard clay sandstone,	2.0		
		Clay shale,	5.0		
Coal,		Coal,	2.0		
		Sandy shales, foliated; then compact; then in half-inch layers,	26.0	Sand rocks,	36.0
		Sandstone, then sandy shales,	10.0		
		Gray shales (blackish),	5.0	Mud rocks,	15.0
		Shaly fireclay,	10.0		
		Greenish sandstone,	6.0	Sand rocks,	14.0
	(r.)	Contorted sandstone,	8.0		
		Fire-clay,	2.0	Mud rocks,	31.0
		Gray, green, harsh shales,	4.0		

		Red and green shales,	5.0	Mud rocks,	31.0
		Very soft gray shales,	20.0		
		Three layers of sand-rock,	6.0	Sand rock,	6.0
Iron,		Soft fire-clay; top slate with nodules,	10.0	Mud rocks,	38.6
Coal,		Coal,	.½		
		Black slate,	.6		
	(s.)	Fire-clay; thin red, green, and yellow shales; then sandy,	6.0		
		Shales, false-bedded,	12.0		
		Ferruginous fire-clay,	2.0		
		Hard, blackish slates,	8.0		
	(t.)	Gray, rough, shaly sandstone and dark shales,	12.0	Sand rocks,	18.0
		Massive sandstone,	6.0		
		Yellow sandstone; soon yellow shales, and then black,	20.0	Sand-mud rocks,	20.0
Iron and lime,	(u.)	Tight blue carbonate,	1.0	Mud rocks,	70.6
Iron,		Green fire-clay, full of nodules of iron,	4.0		
Coal,		Blackish top slate,	3.0		
		Coal streak.			
		Sandstone nodules,	1.0		
Iron,		Shale, yellow, then green, full of nodules of iron,	10.0		
		Soft fire-clay,	1		
		Shale, yellow; then sandy; then clayey; then fire-clay	8.0		
		Fire-clay, blackish; then gray,	10.0		
Coal,		"Boutellier's vein," (?)	2.0		
		Fire-clay,	2.0		
	(v.)	Fire-clay, with nodules,	4.0		
		Shales, blue,	6.0		
Iron,	(v.)	Fire-clay, full of nodules of iron as large as chestnuts,	3.0		
		Clays, various,	12.0		
		Clay, blue-black,	.6		

Shales, red, yellow, and green,	3.0	Mud rocks,	70.6
Wavy, false-bedded, then layered sandstone,	12.0	Sand-mud rocks,	21.0
becomes more of clay,	4.0		
Fire-clay, blue,	5.0		

Last rocks seen at the north side of Great Glace Bay mouth:

Rocks north of Little Glace Bay, ...	471.0
" south " " "	436.0
Total thickness of rocks in the measured section, . .	907 feet.

Beneath these rocks lie the coals (including clay masses) of the cliffs to the east of the Great Glace Bay bar; which I propose to give at another time, in connection with a survey of the coast line eastward.

A few notes to the above section are needful, as follows:

(a.) These rocks cap the square headland projecting into the Gulf of St. Lawrence between the Burnt Head and Little Glace Bay. They are the highest coal-measure rocks of this basin, and perhaps the highest coal-measures south of Sydney Bay. The cliffs are about forty feet high, and exhibit a remarkable contour, caricaturing the human face in profile, by means of the overhanging ledge of hard sand rock at the bottom of the mass, and about half-way of the height of the cliff. See wood-cut (a).

(b.) The upper part of this clay is crowded with small nodules of iron.

(c.) Ranging for a great distance along the cliffs. Stripping it would yield a large quantity of good ore. The plate varies from 4 to 8 inches.

(d.d.) These streaks are not coal, although they resemble it at a distance.

(e.) These shales vary in compactness, but form essentially a homogeneous mass of finely levigated and foliated sandy mud, the top rock of the great coal.

(f.) Of this, only six feet is good workable coal, on the coast, but it increases westward, and with the omission of eighteen inches poorer top coal, yields from six to seven feet of good body coal.

(g.) This mass of building stone is a rare exhibition for these coal-measures. It forms the long point on which the pier is built. Its thickness could not be exactly determined, because like all the very sandy deposits of the section, it is false-bedded and variable. The great sand-rocks underlie all the productive coal-measures, and are seen around Sydney.

(h.) A coal shale, compactly foliated, highly bituminous, burning well, but with much ash, and crowded with fish-scales and minute shells. It sometimes reads thus: Cannel, 8 inches; Bituminous coal, 8 inches; Clay, 1½ inch; Bituminous coal, 3 inches.

(i.) Here comes in a jet-black slate, growing compact like cannel, but

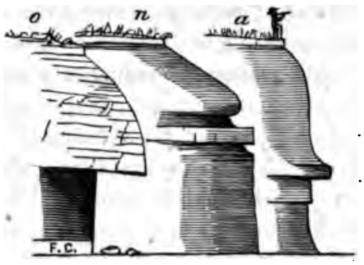
nowhere in the cliff a true coal, but rather a black fire-clay, 1 inch thick with black shales above and below; plenty of fish-scales, but no ferns.

(k.) This becomes solid coal, 6 inches thick.

(l.) Is nipped out at water-level.

(m.) A great mass of sandstone thrown up at a steep angle not by any general structural movement but by original oblique deposition, has here resisted the wearing action of the waves, and left a curious and instructive promontory.

(n.) Burns well. Plenty of fish-scales.



(o.) The profile of this mass is one of singular architectural beauty.

(p.) Form bold, beetling cliffs over the breakers.

(q.) The centre streak is characteristic, for it appears in the outcrop of the same bed at the New Bridge.

(r.) Local false bedding dips form the point.

(s.) The two lower members are variations seen further south.

(t.) Beautifully false-bedded, scalloped in all directions like the blocks and faces of No. X (Upper Devonian) at the viaduct on the Conemaugh, in Cambria County, Penna.

(u.) Sometimes $1\frac{1}{2}$ feet thick, but will not average more than 10 or 11 inches. It forms a long reef into the sea, in the exact line of the distant headland.

(v. v.) The appearance of these fire-clays, crowded with nodules of iron ore, is very striking; their gnarlly, knobby outcrops form long reefs visible by lines of breakers far out to sea.

The above section was obtained in August, 1862, from the cliffs between Lingan and Great Glace Bays, on the east coast of Cape Breton, from sixteen to twenty miles east of Sydney. Part of it was made out by means of a rope and ladder let down from the upper edge of the cliffs, where these overhung the sea, or occupied intervals between the short sand and gravel beaches. At the upper limit of the section, a square headland projects into the Gulf of St. Lawrence, along the axis of a synclinal basin, with sloping sides of 4° or 5°. From this headland southward, the section was made out by an examination of each layer as it emerged from the sea, past the mouth of Little Glace Bay (where the new harbor is constructing, under the skilful and energetic direction of Captain William P. Parrot, Civil Engineer, of Boston, Mass.) as far as to the mouth of Great Glace Bay.

A similar section might be made, for comparison, starting from the same headland westward, along the cliffs, past Cadougan's Creek, which corresponds to Little Glace Bay, to the mouth of Lingan Bay, which in like manner corresponds to Great Glace Bay. Many interesting variations in the metals would appear from such a comparison. While the general regularity and parallelism is remarkable, there are numerous minor irregularities; some fine instances of false bedding and local deposition; lenticular masses of sand separating adjacent mud-rocks; passages of shales into sandstones, and *vice versa;* gradual coalescing of scattered nodules of clay iron-stone into solid plates, or their gradual pervading of a thick bed of fire-clay, hardening it into so refractory a rock, that its outcrop forms a reef far out to sea. Instances occur of the splitting of coal-beds. The Lingan bed, for example, has, on the sea-shore, a clay parting of half an inch, which, in a quarter of a mile inland, thickens to nine inches; and then, in four hundred yards of gangway continued inland, thickens to nine feet, throwing the upper member of the bed entirely beyond the workings.* In this we have probably the explanation of the difference between the abandoned Bridgeport bed, on the south shore of Lingan Bay, and the Lingan bed on the north shore, separated by a wide and gentle anticlinal; the Bridgeport bed being but 7 feet thick, while the Lingan bed is 9.

A second repetition of the lower half of the section was actually obtained from the cliffs to the eastward of Great Glace Bay; in fact, the section was completed by an examination of the lowest rocks which rise here from the sea.

The section here represented includes the productive coal-measures of Cape Breton, with five workable beds of coal, one of which can hardly be called workable in this area, whatever may be its character in others. In Mr. Brown's section of the North Sydney coal-measures, there are enumerated indeed thirty-four coal-seams; but only four are said to be of workable thickness: Cranberry Head, 3.8 feet; interval (measuring downwards) 280 feet; Lloyd's Cove, 5.0; interval 730 feet; Main Seam, 6.9; interval 450 feet; Indian Cove, 4.8. Mr. Brown's whole section extends to a depth of 1860 feet, or along 5000 yards at a dip of 7° to the N. 60° E.

* The *Cook Vein*, at Broad Top City in Pennsylvania, has a sandrock parting two feet thick, between two 2 foot beds of coal. At the present heading of the long drift, this rock, after first disappearing, leaving the bed of coal 6 feet thick, has increased to 10 feet of tough rock, between two 6 inch beds of coal. This increase of ten feet takes place without crush in a distance of only three to four yards.

Mr. Brown "concludes from the best information in his possession that the *productive* coal-measures exceed 10,000 feet," but I saw nothing in Cape Breton to justify the supposition. He grants that, "owing to several extensive dislocations, it is impossible to ascertain their total thickness with any degree of accuracy." I can only suggest, with deference to his long experience and acknowledged skill, that the structure of the east coast of Cape Breton has not been regarded from a right point of view, inasmuch as the coal-beds have been always represented as members of one basin, dipping broadside into the waters of the gulf; whereas, in fact, along that coast, they occur with alternate northeast and southeast dips, forming a series of basin-ends, the bodies of which lie side by side submerged beneath the gulf. The same four or five workable beds inclosed in the same one or two thousand feet of *productive* measures, appear on shore at the west end of each of these basins. As the dip is commonly gentle, viz., from 4° to 8°, the basins sometimes coalesce; but in one instance at least, that of Cow Bay, the *south* dips are 45°, and the basin is sharp and narrow, greatly resembling the end of one of the anthracite basins of Pennsylvania. As at Sydney, and again at Glace Bay, so here at Cow Bay there are but four workable coal-beds in about 1500 feet of *productive* measures, and they are, no doubt, the Glace Bay beds.*

Sir William Logan, Sir Charles Lyell, Prof. Dawson, and other geologists who have described the coal-measures of Nova Scotia and New Brunswick, agree in assigning to them an almost incredible thickness. "The entire section of the Joggins," writes Sir William Logan, "contains 76 beds of coal and 90 distinct stigmaria underclays," with "24 bituminous limestones," in "a vertical thickness of 14,570 feet."

When we analyze the eight divisions into which this immense mass has been distinguished, we find them thus constituted:

Nos. 1, 2. Sandstones and shales; drift-trees and erect calamites, ...	2267 feet.
No. 3. Sandstones; coal shales; underclays; 22 coal-beds,	2134 "
No. 4. Sandstones and shales, gray; bituminous limestones; 45 coal-beds; shells and fish-scales, ...	2539 "

* The combined thickness of the Lower, Middle, and Upper Coal-measures, as determined by Mr. Jukes, in South Staffordshire, England, is 1810 feet. The thickness of the productive coal-measures of Leicestershire does not exceed 2500 feet. In most parts of the deep Anthracite basins 2000 feet would be a fair average. In Western Virginia and Pennsylvania, and in the deepest parts of the Mississippi Valley areas, 1500 feet.

No. 5. Sandstones and shales, red; carbonized plants, .	2082 feet.
No. 6. Sandstones, ⅔; shales; bituminous limestone; 9 coal-beds; shells and fish-scales, ...	3240 "
Nos. 7, 8. Sandstones, conglomerates, shales, nod. limestones, two beds of gypsum; remains of plants, .	2308 "
Interval, ...	300 "
Massive limestone with Prod. Lyelli and other Lower Carboniferous fossils.	

It is very evident that the Sydney, Glace Bay, or Cow Bay section of less than 2000 feet of productive coal-measures, can represent but barely one of these divisions, and that it must be either No. 3, or No. 4, or No. 6. Sir William Logan adds, in his resumé, that "Nos. 3, 4, 5, and 6,* contain the equivalents of the productive coal-measures of Pictou and Sydney, and in part of the sandstones which separate them from the Lower Carboniferous series." Prof. Dawson describes minutely his own section of "2819 feet of the central part of the Coal Formation,"† in approaching which, after describing the lower parts,‡ he says: "We have now, after passing over beds amounting altogether to the enormous thickness of 7636 feet, reached the commencement of the true coal-measures."§ By the *true coal-measures* he means, therefore, Division No. 4 and the lower part of Division No. 3, embracing less than 3000 feet of measures and containing but four coal-beds which can be called workable, the rest being from one inch to eighteen inches thick. In descending order we have:

Nine small seams in a thickness of measures of . .	536 feet.	
Main coal seam, 3.6; parting, 1.6; coal, 1.6, . . .		5.
Three minute seams in an interval of	75 feet.	
Coal, .3; clay, .5; Queen's vein, 1.9; shale, 4.4; coal, 1.0,		3.
Ten small seams (largest 1.2) in an interval of . .	762 feet.	
Coal, with three clay partings, ...		2¾.
Three small seams in an interval of	206 feet.	
Coal, ...		5.
Three small seams in an interval of	17 feet.	
Coal, ...		4.
Interval of	32 feet.	
Coal and bituminous shale, ...		5.
Eleven small seams in an interval of	1153 feet.	

The aspect of this section resembles those on the east coast of Cape Breton, where modiolæ and fish-scales are also abundant.

* Dawson's Acadia, p. 178. † P. 177. ‡ P. 127.

§ Described in Proc. Geol. Soc. X, pp. 1–42.

The Albert or Pictou section is said also to contain but five or six seams of coal, two of which are of unusual thickness, as follows: From the surface, down the Success Pit, 73 feet; Main Coal, 39.11 feet thick; Interval, 157 feet; Deep Seam, 24.9. Both these coal-beds, however, are far from presenting solid faces of coal. On the contrary, they are built up, like the 30 and 60 foot coal-beds of the Anthracite region of Pennsylvania, of many layers separated by under-minings. The peculiarity here is that these separations are plates of ironstone, not more than six inches thick, instead of being layers of fire-clay, coal-slate, or sandstone. The structure is certainly peculiar, and evinces quietness of deposit and long-continued stability of sea-level, unless we prefer to consider the Pictou area as an upland swamp, unaffected by certain changes of relative land and sea level then going on and affecting the swamps of the coal era around and below it.

But inasmuch as the 60 foot coal at Mauch Chunk, on the Lehigh, is identifiable with the Low Main or Mammoth bed of the Pottsville Basin to the west, and of the Beaver Meadow, Hazleton, Buck Mountain, and Wyoming Basins to the north of it, and through them with still smaller and separated beds further off in the Mahanoy and Shamokin Basins, and even with the bituminous basins of the Alleghany Mountains,—there can be no reasonable doubt, *a priori*, that the 25 and 40 foot beds of Pictou are identifiable with 5 and 6 foot beds of New Brunswick on the one side, and with the 8 and 9 foot beds of Sydney on the other.* The palæontological unity of the Low Main coal of the Pittsburg region with the Low Main coal of Eastern Pennsylvania admits of no doubt. The structural evidence is coincident and precise. Yet, wider intervals of Devonian and Silurian denudation are to be bridged by the theoretical connection

* To illustrate in a still more striking manner this separation of a large bed into several smaller ones, one has only to examine Mr. Jukes's description of the Thick Coal of Dudley, in England, "which, forming at that place *one* solid seam ten yards in thickness, becomes split up into *nine* distinct seams by the intercalation of 420 feet of strata over the northern area of the coal-field." The Main Coal of the Warwickshire area is split up, according to Mr. Howell, into *five* beds by 120 feet of intervening strata. The Main Coal of Moira is noticed by Mr. Hull as a third instance. (See Hull's Paper on the Carboniferous Strata of England, Vol. XVIII, No. 70, Quar. Jour. Geol. Soc. p. 139.) Mr. Lesquereux, in his Report on the East Kentucky Coal-Field, in the fourth volume of Owen's State Reports, p. 360, gives what he considers sufficient evidence of a similar breaking up of the Low Main Coal of the Pittsburg area into three. This is precisely the normal number of large beds into which the great Mauch Chunk or Mammoth Bed separates throughout the Pottsville-Tamaqua Basin.

there, than are called for between the coal areas of the British Provinces. The general bordering of the sea-coast with coal-beds, and the long and parallel stretches of Carboniferous rocks through the interior, are all cogent arguments for continuity of the original coal areas, and therefore for the contemporaneity of the remaining portions of the coal-beds. As the same coal-beds which now cap the highest mountains of the Alleghanies in Northern Pennsylvania, and have been swept away over wide intervals of Devonian valleys between them, descend also into the depths beneath the beds of the lowest valleys drained by the Swatara, the Schuylkill, the Lehigh, and the Susquehanna North Branch, so I have no doubt the coal-beds, whose edges we now see only along the sea-shore of Nova Scotia, or on the sides of the interior low lands, did once ride over the tops of its metamorphic Devonian mountains, whose summits, crowned with cliffs, opposing anticlinal and synclinal dips, remind the Pennsylvanian geologist, at every view he takes of them, of those mountains on which the coal still lies in fragmentary patches in his native State.

What, then, are the thousands of feet of rocks included in Divisions Nos. 5, 6, 7, and 8, of Logan's great section? In other words, the 7630 feet over which Dawson climbed to reach the bottom of his "true coal-measures?"

What, I ask in reply, are those wide stretches of low, rolling, arable country, with a red shale soil, which the traveller sees spreading around all the productive coal areas of Cape Breton and Nova Scotia, especially the latter? To the geologist from the West they afford familiar scenery. He can hardly persuade himself, sometimes, that he is not riding through Lykens or Locust or Catawissa or Trough Creek Valleys in Pennsylvania, over the chocolate-colored soils of No. XI. This formation, 5000 feet thick around the southern Anthracite coal-fields, becomes, indeed, thinner and thinner northwestward, until it is but 500 in the Alleghany Mountains, and not more than 50 beneath Pittsburg. But along its thickest line it extends from Alabama to New Jersey, a good thousand miles. It is not surprising, then, to see it stretching still another thousand miles further in the same direction, and spreading undiminished around the coal areas of Nova Scotia.

Division No. 5 of Logan's section, consists of red shales and sandstones chiefly, 2012 feet thick. There is no reason why this should not be the representative of Formation No. XI, or of its upper part.

If it be objected that Division No. 6 is in fact a coal system with nine beds of coal and numerous bituminous limestones, the objection

becomes an additional argument for the identification. For we see in this No. 6 the reproduction, at this immense distance, of the Lower or False Coal-measures of Virginia, where a *productive* coal system underlies the chocolate shales of Formation No. XI, and not only reappears, with workable beds, in Eastern Kentucky and Middle Tennessee, but projects itself, in a recognizable shape, through Western Indiana nearly to Chicago, and through Middle Pennsylvania nearly to the Delaware River. In fact, Lesquereux pronounces the whole coal of Arkansas to belong to this lower system. It may, therefore, very well be found in force in Nova Scotia. Throughout Division No. 6 no bed of respectable size is mentioned. It is an early and imperfect system.

The chief objections to this hypothesis above sustained, will come, 1, from the absence of any general representative for the Millstone Grit or Great Basal Conglomerate of the True Coal-measures; 2, from the sub-position of Divisions 7 and 8, 2308 feet of sands, pebble-rocks, and limestones; and 3, from the presence at a still lower depth of what seems to be the genuine, massive, subcarboniferous limestone. To break the full force of these objections, I can only remark, 1, that the Pictou coal-basin *has* a massive Conglomerate under its productive coal-measures, while elsewhere no one Formation of the whole Palæozoic System is so variable and unreliable and unidentifiable as Formation XII, the Great Conglomerate, technically so called; 2, that Nos. 7 and 8 may be identified with Formation X; and 3, that the subcarboniferous or Archimedes Limestones of the Western United States not only have been subdivided into five separate formations in the Valley of the Mississippi, but wholly thin away and disappear before crossing the Schuylkill and Lehigh Rivers on their way to Nova Scotia. Therefore, although the False or Lower Coal-measures of Virginia and Southwestern Pennsylvania are *overlaid* by limestones with subcarboniferous fossils, the connection, *as to limestone*, is entirely cut away between them and the Nova Scotia deposits, so that the massive gypseous limestones of Nova Scotia may be at any assignable lower level. This argument is rendered all the more forcible by the fact that gypsum is unknown in the United States, except in one or two anomalous positions, apparently connected with the Lower Silurian Limestones, and in the closed basin of Michigan.

Beneath the red shale Formation No. XI, we have, in the southeastern ranges of the Appalachians, nearly three miles' thickness of sedimentary deposits, separable everywhere into three great Forma-

tions: No. X, white sandstone, 2000 feet, No. IX, red sandstone, 5000 feet, No. VIII, green and olive shale, 8000 feet; the white sandstone including rarely a thin bed of conglomerate here and there, and traces of coal-plants and even thin coal-beds; the red sandstone passing downwards into red shale, and often alternating flinty sand-rock with massive mud-rocks even in the upper part; and the olive shale becoming near the base of it rocky, and even mountainous in the region of the Juniata, where a system of thin coal-beds was also developed in the midst of the sandstone and shale. The white sandstone of No. X becomes in the Alleghany Mountain belt less than 800 feet thick, and is there characterized by thin-bedded and very irregularly cross-bedded sandstones of a peculiar greenish tint and harsh, rough fracture, weathering to a surface sprinkled with small red dots of peroxide of iron.

It is not too much to say that a geologist well accustomed to these formations, along their great Appalachian belts of mountain and valley, stretching from the Appalachicola and Alabama Rivers in the South, to the Delaware and Hudson in the North, cannot fail to recognize them and distinguish them anywhere. The *tout ensemble* or *facies* of each is *sui generis*. Fossils may come in afterwards as a satisfactory confirmation; but the eye has already determined the respective formations. Even in the West, where Formation IX has dwindled, like Formation XI, to an insignificant one or two hundred feet, and scarcely separates the green sands of X from the green shales of VIII, the characteristic features of the three formations, although modified and harmonized by the preponderance of the argillaceous element, are still in sufficient contrast to be recognized when fairly seen.

To an eye thus trained among the broad outcrops of the Lower, Middle, and Upper Devonian of the Appalachians, it is evident that the mountains of Cape Breton and the hills of Northern Nova Scotia, surrounding or intervening between the already-mentioned red shale borders of the coal areas, are composed of these formations. True, the anticipation of finding these formations has a tendency to warp the judgment and delude the eye, especially when that anticipation is based upon such a probability as this: that a massif, three miles thick and a thousand miles long, will maintain its thickness (and of course its topographical height and geographical breadth) at least as far along the prolongation of its isometric axis (to use Mr. Hull's new and much-needed term), as will such minor formations as the Coal over it or the Upper Silurian limestones under it. In other

words, if analogies between the Nova Scotia and the United States coals compel us to consider them synchronic, if not originally conterminous; and if the Clinton fossils of New York, and even the Dyestone* iron ore of Pennsylvania, Tennessee, and Wisconsin, be found at Arisaig, and along a well-defined outcrop in the direction of Truro; surely the Second Mountain, Little Mountain, Orwigsburg Mountain, and Summer Hill, upon the Schuylkill River, must be represented by the Antigonish Mountains of Nova Scotia, and by the Sydney and St. Peter's Range in Cape Breton: and this, whether the Nova Scotia carboniferous rocks or subcarboniferous limestones be deposited upon the Devonian conformably or unconformably. The Province is in fact a wide belt of mountains partially submerged; and may have been to some extent in the same condition at the beginning of the Coal era. In the Antigonish Hills we may have principally Formation VIII, while in the country south of the Lake Bras d'Or we may have the full series of VIII, IX, and X. The Arisaig formation, with fossils once thought by Hall and Lyell to be Hamilton and Chemung, and now considered by Hall and Dawson to be indisputably Clinton, although overlaid and concealed along most of its extent by apparently nonconformable coal-measures, gives us a fixed lower limit for the so-called metamorphic hill country of the Province, which makes this hill country necessarily Devonian, or Formations VIII, IX, and X. Even if we object to the term Devonian, and permit the palæontologists to carry down the term Carboniferous, or the term Subcarboniferous, step by step, so as to include first, Formation X, perhaps rightly, and then the genuine Old Red IX, and even, as the effort is in the Western States, to include Formation VIII down to its black shale beds with coal, the change of term will not change the lithology,—the mountains of Nova Scotia must still be the representatives of the Catskill, Mohantongo, Terrace, and Alleghany Mountains of New York and Pennsylvania.

The eye can hardly be mistaken in the features of the roadside banks between Antigonish and Merigonish; the road defiles through hills of VIII. Equally certain is it that the outcrops on the road from St. Peter's to Sydney are of the reddish and greenish sand rocks of IX and X. The road for forty miles winds along the lake shore, and in and out of ravines descending from a group of parallel mountains of these formations, made parallel by a system of parallel anti-

* Described by Dawson, p. 58, supplementary chapter to Acadian Geology, August, 1860.

clinal and synclinal curves which issue from the lake and throw the mountain dips to the north and to the south alternately, at angles from 5° to 45°. Great rib-plates of flinty sand rock rise to the summits and form tablets with broken cliffs upon the outcrop side, fine objects seen thus against the sky. The mountains at the head of the east arm of the lake, and those on its northern side forming the peninsula, come down upon the shore in the same style, and belong to the same system. On the south side of Miré Bay, in the ravines east of the Gabarus road bridge, there is no mistaking the aspect of masses of slates of No. VIII standing at 45°; nor can one be convinced that he is not riding through a forest grown on a soil of IX, as he is whirled over the fine old road from Miré bridge to Louisburg, although the highest elevation of the plateau is but 350 feet.

Whatever impression the Devonian and subcarboniferous sediments of Nova Scotia and Cape Breton may make upon a geologist from the Middle States, certainly his wonder will be piqued by striking analogies between the exhibitions of the workable coal-measures at two such distant places as Sydney and Pittsburg. The resemblance is more than general; it has special points.

At Pittsburg there are about a thousand feet of coal-measures (to the top coal), with a great bed 8 or 10 feet thick near the top, a 6 foot bed half way down, two small workable beds in the lower half of the column, and a large bed (4 to 8 feet) at the bottom.

At Sydney (Glace Bay), in like manner, there are about a thousand feet of coal-measures, with an 8 or 9 foot bed towards the top, a 6 foot bed half way down, two smaller beds in the lower half of the column, and a 7 or 8 foot bed near the bottom.

At Pittsburg, as at Glace Bay, the upper 18 inches or 2 foot of the High Main coal is rejected.

At Pittsburg, as at Glace Bay, the middle 6 foot coal (Upper Freeport of the Alleghany River and Cook Vein of Six Mile Run) is famous for its solid face and excellent quality.

No one should admit that such coincidences furnish a demonstration of identity. But it must not be overlooked that the beds of the Pittsburg area have been traced and identified from end to end of areas with a diameter, in all, of over a thousand miles, even across the denuded interval of Central Kentucky. The expectation may, therefore, be pardoned, not as an amiable enthusiasm, but as a logical inference, that when the fossil groups of the individual beds of Cape Breton shall have been thoroughly studied by Lesquereux and other competent botanists, their identification with the beds of the

West may be made somewhat more than possible. The zone of sediment, when taken along its isometric axis, is equal enough over *a priori* incredible distances. Logan and Hunt and Murchison are finding the Quebec group, the Huronian and Laurentian systems in Scotland and Scandinavia, not by fossils, but by aspect. No one doubts the extension of the Millstone Grit and the Mountain Limestone of England to Pennsylvania. Why should the remarkably homogeneous and continuous Flora of any one of the immensely outspread beds of the United States not be homogeneously continuous to Rhode Island, New Brunswick, and Cape Breton?

One remarkable feature, however, in this resemblance of the two coal columns at Pittsburg and Sydney, must not be forgotten. I refer to the mass of red shales which cap the Glace Bay section. A similar deposit occurs, at a fixed horizon, widely spread over Western Pennsylvania, but *beneath,* not *above,* the High Main coal.

Dr. Wood noticed a visit which he and Prof. Henry had made to Dr. Wistar's house, since the meeting of September 19th, to re-examine the lightning rod connections, and they found this case to be no exception to the general rule, that where the connections are perfect, the building is secure. Dr. Bache described the connections of his house-rods at the corner of Spruce and Juniper Streets, with the city gas pipes.

And the Society was adjourned.

Stated Meeting, November 21, 1862.

Present, seventeen members.

Judge SHARSWOOD, Vice-President, in the Chair.

A letter accepting membership was received from T. J. Lee, dated Washington, November 11, 1862.

A letter announcing the decease of M. Edmi-François Jomard, at his residence in Paris, September 23d, 1862, aged 85, was received from his son and other relatives, dated Paris, September 30, 1862.

Letters acknowledging the receipt of Transactions, Vol. XII, P. 1, 2, were received from the Massachusetts Historical Society; the Academy of Sciences of St. Louis; and the Secretary of the Board of Trustees of the New York State Library.

On motion of Dr. Bache, the New York State Library was placed upon the list to receive the Transactions as well as the Proceedings.

Donations for the Library were received from the Natural History Societies at Riga, Berlin, Boston, New York, and Philadelphia; the Royal Society in Dublin; the Franklin Institute; Dr. Wolf and Dr. Zeuner, in Zurich; Prof. Zantideschi, in Padua; M. Jomard, of Paris, and Dr. Pugh, of Centre County, Penna.

The attention of the members was directed to the portrait of Alexander Dallas Bache, ex-President of the Society, Superintendent of the United States Coast Survey, painted by Huntingdon, and deposited by Mr. Bache for safe-keeping in the Rooms of the Society.

Mr. Peale read to the Society a communication from Mons. A. Morlot, of Lausanne in Switzerland, on the copper age of North America.

Mr. Peale mentioned certain facts of interest, in relation to a stroke of lightning at Cape May, showing that even when there was no break in the continuity of the conducting rod, the fluid preferred to leap six feet from it to a gaspipe and thence to the earth where it was more moist, than that into which the rod was inserted at its foot.

The minutes of the Board of Officers and Council were read.

New nominations Nos. 465 to 477 were read.

Prof. Kendall asked to be excused from preparing an obituary notice of General Mitchell, and on his motion, Prof. Coppeé was appointed in his stead.

And the Society was adjourned.

On the Date of the Copper Age in the United States.
By A. Morlot.

The series of the *Smithsonian Contributions to Knowledge* opens with a splendid volume on the "Ancient Monuments of the Mississippi Valley," by Squier and Davis (Washington, 1848). In this work, as glorious a monument of American science, as Bunker's Hill is of American bravery, the authors have revealed the former existence, over a vast extent of the North American continent, of a most singular civilization, characterized chiefly by the use of native copper, derived from the district of Lake Superior, and spread, doubtlessly, by commerce over the whole country. Hence we may call those times the *copper age* of North America. The once prosperous civilization of that age faded away, and left the field to the red man, in the savage state in which he is still known to exist. Messrs Squier and Davis have shown, that the virgin forests, growing on the earthworks of the copper age, must have taken for their full development at least one thousand years, and the Normans who visited America eight centuries ago, evidently only met there with savages.

Some more light seems to be thrown on the date of the copper age, by the fact recorded in Schoolcraft's *Indian Tribes*, Vol. I, page 103. I have gone over the passage carefully, and I think the statement of which I am going to make use, bears inner evidence of being correct. Schoolcraft informs us, that at Beverly, twelve miles from Dundas, Canada West, there were discovered about 1837, extensive ossuaries, which he examined himself, and that among the bones were found amulets of the red pipestone of Coteau des Prairies (Minnesota), copper bracelets like those of the old graves in the West, a *Pyrula spirata* and a *Pyrula perversa*, both from the Gulf of Mexico, four antique pipes used without stems, and corresponding with an antique pipe from an ancient grave at Thunder Bay, Michigan, a worked gorget of sea-shell, with red nacre, and shell-beads of the same kind as those said to have been found in the gigantic mound of Grave Creek, Virginia. All this goes to characterize the ossuaries of Beverly as belonging to the time of the mound-builders, that is, to the copper age. But these ossuaries have also yielded some beads and baldrics of glass and of colored enamel, figured by Schoolcraft on Plate XXIV and XXV. The find is not single of its kind, for according to Schoolcraft, beads agreeing completely with those of Beverly, were found in 1817 in antique Indian graves at Hamburg,

Erie County, New York.* Schoolcraft distinctly points out the beads of Beverly as being of European origin. This is unquestionable, for we know that the native industry of America had never produced glass or enamel. At Copenhagen, I discovered in the archæological museum (Altnordisk Museum, Director, Mr. Thomsen), a bead (Fig. 1), identical both in color and in its intricate composition with Figs. 11, 12, and 13 of Plate XXIV, of Schoolcraft, only a little larger, since it measures one and a half inch (English) in length. It bears the number 12,390, and is put down in the catalogue as having been found near Stockholm, in Sweden, and as bought at an auction. A fragment of a second bead (Fig. 2) of the same workmanship, but still larger, exists in the museum at Copenhagen. It bears the number 5211, and is noted as coming from a grave-mound near Skœrpinge, in the Danish province of Jutland, and as having been bought at the sale by auction of Bishop Mynter's collection in 1839. Unfortunately these indications furnish no chronological date.

I bought at Hanover a baldric (Fig. 4), formed of a tube one and a half inch long, of colorless glass, with alternate longitudinal streaks of white and red enamel, quite of the same type as Figs. 13, 14, 15, 20, and 21 on Plate XXV of Schoolcraft. My specimen has had a beginning of melting, and must be of the time when the dead were burnt. But in parts of Northern Germany that custom prevailed, along with paganism, until after the tenth century, so this does not teach us much as to the age of these baldrics.

The beads mentioned at Copenhagen and the baldric of Hanover are so rare, that I have not noticed any others of the sort in the large museums of Lund, in Sweden, Copenhagen and Flensburg, in Denmark, Schwerin, Hanover, and Mainz, in Germany. They are not post-Roman. The beads of those times are very different, and of coarser manufacture, nor can I consider them as Roman. In the Museum at Copenhagen, there is one of these glass balls, of very elaborate workmanship, 1¾ inch in diameter, called *Millefiori* (in Italy also *Fiori di S. Tennara* and *Vasia Fiori*), with a sort of mosaic or tessellated work, of differently colored enamel inside.† The specimen is put down simply as having been found in Denmark, and I was told that another of the same sort had been found in the south of Sweden. The Danish specimen shows, among the variously colored designs of the mosaic in its inside, one bit exactly of the

* Second Part of Lead Mines of Missouri, New York, 1819.

† Mentioned at page 57 in my paper translated by P. Harry in the Smithsonian Report, 1861.

same type, consequently of the same date, as the two beads mentioned in the same museum. These balls, according to Minutoli's excellent paper on the stained glass of the Ancients (Berlin, 1836), are not of Roman origin, and are found in old Etruscan graves; also in Egypt, where they may have been manufactured at Alexandria, before the Christian era, perhaps as far back as the golden times of the Phœnicians, who were celebrated for their glassware, as well as for their commerce, and for their extensive navigation. That they sailed on the Atlantic is known, and it is probable that this was the route by which their glass reached the Baltic countries, since it appears to be missing in a general manner in Southern Germany and in Switzerland. We know besides, that the Phœnicians carried on a regular trade with Gades (Cadiz), where they met with the traders from the North.

It follows, that those glass beads and baldrics from the ossuaries at Beverly are anterior to the Christian era, and that America appears to have been visited already at that remote period by Europeans, most likely by those skilful navigators, the Phœnicians.

The discovery of America by the Phœnicians has been strongly suspected by many, and it would account in a very natural manner for the tradition of the Atlantis. The fact in itself is far from appearing improbable, when we reflect that long before the Christian era, the Alexandrian astronomers knew the earth to be round, and that one of them, Eratosthenes (third century before Christ), calculated the circumference of the earth with a surprising degree of accuracy. The celebrated French antiquarian, Letronne, examining this question with his usual penetration, even comes to the conclusion, that Eratosthenes only applied to his own imperfect data the measurement of a degree of the meridian, carried out long before his time.* There are also other circumstances, indicating a remarkable degree of civilization and of scientific pursuit in those remote times of the Phœnician prosperity.

The find at Beverly goes to show, that a given moment of the American copper age coincided with a given moment of that European civilization, to which the enamelled beads mentioned belong, and which can hardly reach lower down than the Christian era, while it appears to go as far back as five, or even ten centuries earlier. Of course it is not to be understood, that the American copper age was

* Pytheas und die Geographie seiner Zeit, von T. Lelewel. Hoffman, Leipzig, 1838. A capital little book, containing also Letronne's paper.

wholly parallel with the Phœnician period. It may have begun sooner, and may have lasted later.

We have thus obtained by indirect means, a chronological determination for the North American copper age. It is far from precise, but further discoveries will correct and improve it. May the interesting subject be taken up with that spirit of true scientific research, so justly to be admired in Squier and Davis's invaluable volume!

Lausanne, Switzerland, 26th June, 1862.

Explanation of the Figures.

Fig. 1. Bead of enamel, or opaque stained glass, in the Museum at Copenhagen, said to have been found near Stockholm, Sweden.

Fig. 2. Fragment of bead of the same sort, in the same Museum, from an antique grave in Denmark.

Fig. 3. Bead of the same sort, from the ossuaries of Beverly in Canada, as given by Schoolcraft.

Fig. 4. Baldric of glass, bought at Hanover, Germany.

Fig. 5. Baldric from Beverly. Schoolcraft's Indian Tribes, Vol. I, plate XXV, fig. 14.

Stated Meeting, December 5, 1862.

Present, eleven members.

Judge Sharswood, Vice-President, in the Chair.

Mr. Cornelius, a newly-elected member, was introduced and took his seat.

Mr. Dawson accepted membership, by letter dated McGill College, Montreal, November 25, 1862.

A letter acknowledging receipt of Transactions XI, XII, 1, 2, was received from the Regents of the University, dated Albany, Nov. 2, 1862.

A letter from Admiral Dupont to Mr. B. Gerhard was read, requesting that a copy of Mills' Atlas of South Carolina, captured at Beaufort in November, 1861, be presented to the library.

A letter from Charles Rau, New York, was read, requesting information respecting one of the Society's publications.

A letter from G. W. Israel, dated Philadelphia, December 5, 1862, was read, respecting certain alleged geometrical discoveries, and requesting a committee.

Donations for the library were received from the L. and P. Society of Manchester, the Essex Institute, the B. N. H. Society, the Editors of the Am. Jour. of Science, the Superintendent of the Census of 1860, and Admiral Dupont.

The committee to which was referred the paper of Mr. Chase on "Intellectual Symbolism," reported in favor of its publication in the Transactions; and gave a critical review of its scope and character. On motion of Mr. Fraley it was so ordered to be published.

The Treasurer read his annual report, which was referred to the Finance Committee.

The Publication Committee presented their annual report.

Pending nominations Nos. 465 to 477 were read.

And the Society was adjourned.

Stated Meeting, December 19, 1862.

Present, twenty-one members.

Professor Cresson, Vice-President, in the Chair.

A letter accepting membership was received from Dr. F. T. Frerichs, dated Berlin, November 21st, 1862.

Letters acknowledging the receipt of publications were received from the Society of Antiquarians of London, November 28th, and the Corporation of Harvard College, December 8th, 1862.

Letters respecting donations were received from Dr. Jarvis, Dorchester, Mass., December 12th, and Dr. George Smith, Upper Darby, December 9th, 1862.

Donations for the Library were received from the Royal Astronomical Society, the American Antiquarian Society,

Franklin Institute, Messrs. Isaac and M. C. Lea, Mr. R. Vaux, and Dr. Smith.

The death of Ellwood Morris, a member of this Society, was announced as having taken place in November last in North Carolina, while in the service of the Confederate States.

Dr. Emerson exhibited specimens of syrup and sugar manufactured from the Sorghum cane, and described the process by which the sugar was allowed to separate itself and crystallize spontaneously.

The culture, he said, of the Sorghum Saccharatum in our Middle, Northern, and Western States, has spread with marvellous rapidity, and in seven years, added millions of dollars to our agricultural resources. The amount for 1862 cannot be less than six millions of dollars for the saccharine products alone. From what has been already accomplished, and the further expansion sure to follow, we are authorized to regard the introduction of the Chinese sugar-cane of the Northern provinces, the richest acquisition to our agricultural resources since that of cotton. It bids fair to secure us very soon from the tropical monopoly which has so long existed for the supply of sugar. The short history of its introduction into Europe and America is highly interesting.

In 1851, some seeds of various Chinese plants were sent from Shanghae to the Geographical Society of Paris by the Count de Montigny, the French Minister to China. These were distributed by the Paris Geographical Society to different parts of France. Some went to Toulon, where they were planted in the Marine Gardens, under the direction of M. Robert. With all his care, he only succeeded in getting one seed of the sugar-cane to germinate, and was so fortunate as to guard the single offspring, and bring it to maturity. This was in 1852. Some of the seed of the solitary plant fell into the hands of a skilful gardener at Hyéres, who gathered his little crop in 1853. Eight hundred of these seed were purchased by Vilmorin, Andrieux & Co., seed merchants at Paris, who paid for them no less than eight hundred francs! M. Vilmorin planted his seed in 1854, and obtained a rich return. In the progress of their growth, he made experiments with the plants in different stages, and at the close of the year 1854, published his "Researches upon the Sorgo Sucré." In November, 1854, Mr. D. Jay Browne, of the United States Patent Office, returned from Europe to America, bringing

some of the seed of this Chinese sugar-cane, procured from M. Vilmorin. These were distributed throughout our country, and have been the means of bestowing upon it the rich returns we are now enjoying.

Though so valuable as a sugar-producing plant in Northern climates, its value does not stop here. In its green state, it yields the greatest amount of rich, succulent forage to the acre of any other plant, being eminently adapted to resist droughts. Previous to sugar-making, a large amount of fodder is stripped from its tall stalks, and cured for winter forage. The seed, which are abundant, are excellent for feeding to poultry and farm stock, and even for making into bread. From the hull of the seed, a rich purple with other tints have been extracted, formerly unknown in Europe. For feeding purposes, the seed products are fully equal to an oat crop from the same measure of ground. As an alcoholic producer, nothing else can compare with it, and this now appears to be the chief purpose to which it is consigned in Southern Europe and Algeria, where it is extensively cultivated. The spirit yielded by the first distillation is fully equal, if not superior to what can be obtained by double distillation from the grape, which for this purpose it has almost superseded. The necessity of the cereals to be used as bread, led to a prohibition of their distillation, but their place has been unexpectedly supplied by a far better alcoholic material. In the United States, the sugar products have been mainly sought after, and common farmers are now turning out the richest of syrups in millions of gallons, twelve pounds to the gallon, each capable of furnishing seven and a half pounds of crystallized sugar. But little capital or skill is required, and the common farm mills to press the canes, and newly invented evaporators to reduce the fresh juice to syrup, cost comparatively little. The whole apparatus to make one hundred to one hundred and fifty gallons of syrup a day, can be obtained for about the price the farmer pays for a good grain thresher, say $200 to $250. The improved evaporators reduce the fresh juice to thick syrup in the almost incredible short time of twenty to thirty minutes, and at an expense of less than fifteen cents per gallon. The bagasse, or residue of pressed cane, after being dried, is made into bales, and finds a ready market at the paper mills.

Though the richest land will produce the larget canes, the saccharine product is not always in proportion to the weight of the cane. Vegetable mucilage with nitrogenous matters often take the place of sugar. Hence, soils of moderate fertility will often yield more sugar

to the acre than much richer land. I have known land which would not yield over twenty bushels of Indian corn per acre, give one hundred gallons of the richest sorghum syrup; as much as has been produced in some other places from land yielding fifty and sixty bushels of corn per acre. Although I have stated the produce of the sorghum at some one hundred to one hundred and fifty gallons per acre, this is but a moderate estimate. Mr. Lovering obtained at the rate of sixteen hundred and twelve pounds of sugar, and eighty-two gallons of molasses per acre, and states that he had heard of an instance where the product near Philadelphia was at the rate of four thousand four hundred and ninety-nine pounds of sugar, and two hundred and seventy-four gallons of molasses to the acre! He gives the strongest reasons to believe, that the saccharine yield per acre of the Chinese sorghum in the Middle States, will be fully equal to that from the tropical cane in Louisiana.

In Europe, where they have been so extensively engaged in manufacturing sugar from the beet, this root has been found to furnish the largest proportion of crystallizable sugar in the Northern provinces, where the great manufactories now chiefly exist. Reversing this order, the Chinese sorghum yields its greatest amount of crystallizable sugar in the Southern provinces.

As yet no regular plan has been adopted in this country to separate the sugar of the sorghum syrup from its glucose, and some expert chemists have been signally foiled in their efforts, and even gone so far as to pronounce it impracticable. Others have succeeded much better. Among these, I will name Mr. J. S. Lovering of this city, an extensive sugar refiner, who has most satisfactorily demonstrated the practicability of obtaining from sorghum raised near Philadelphia, all the grades of sugar, from the lowest quality of Muscavado to the best loaf. No fears need be entertained that this object will not soon be attained through easy methods. Meantime there seems to be a strong tendency in syrups well manufactured from mature cane, to deposit, under certain favorable circumstances, granulated sugar spontaneously. Instances of this kind have come under my notice, where considerable quantities of granulated sugar were obtained without any artificial process. The field is fairly open to experiment, and rich rewards may soon be confidently expected. The similarity existing between the climates of the United States and China, leads us naturally to anticipate superior advantages from the culture in our country of the sugar-cane of the Northern provinces of China.

Professor Trego gave his own observations of the culture of Sorghum in Berks County, Pa.

Professor Cresson remarked upon its disposition to hybridize with broom-corn, and other varieties, and its consequent deterioration.

Judge Hare made a verbal communication upon the probable tendencies of the modern theories of the metamorphoses of force.

Mr. Cornelius exhibited specimens of unannealed glass, and illustrated its brittleness.

Professor Coppée exhibited specimens of rifle, musket, mortar, and cannon powder, and described the perforated Rodman powder for fifteen-inch columbiads. Mr. Tilghman explained the difficulties once encountered, in producing a powder so well mixed as to explode rapidly, and how the opposite quality is now a desideratum.

Mr. Peale read the following extracts from a letter from Mons. A. Morlot, of Lausanne, dated November 6th, 1862.

"There is certainly some similarity between the European and the American stone age. Where the elements were so simple, great dissimilarity could not have prevailed. But some dissimilarity does evidently exist; and what strikes me most in comparing the collections, is to see the superiority betrayed by the European remains. With certain analogies with savage life, there are here decided tokens of civilization. Then also it would appear as if the arts of peace predominated with us, whilst your numerous tomahawks, entirely wanting here, attest of more ferocious dispositions. But these are only ideas, to which I do not attach any value. Much more study and research is necessary, to see a little clearer into the matter. We know as yet fearfully little.

"You have looked out chiefly for stone. Field study will be sure to lead to the discovery of the sites of ancient dwellings, where plenty of other remains than stone or pottery will be found. *One* good spot, carefully examined, can teach a great deal.

"The Americans will have great trouble in establishing a stone age anterior to the copper age, and in distinguishing it from the stone age posterior to the copper age. And yet this distinction must be made, if a satisfactory idea of the past is to be arrived at. You will

have to look out chiefly for good examples of ***superposition***. It is a chance to find them, but then such chances will befall those who seek. I have had special good luck with the Tiniere,* but then how often have I examined railway cuttings in vain! The chance consisted more in finding the thing at a short hour's walk from Montreux, where I often stay, so that I could visit and revisit the spot very easily. The bones from the stone age stratum have been re-examined by Professor Rustimeyer. From what he says, I am led to think that they indicate the end of the stone age, or the beginning of the bronze age. This would be very important, for then we should thus get at an evaluation of the duration of the bronze age, since the tweezers found in the bronze age stratum, at a depth of ten feet, belong to the end of the bronze age. Hitherto we were left without the faintest idea how long the bronze period might have lasted.

"It would be of the greatest interest, to make a careful investigation of the ancient copper diggings on Lake Superior, before the modern works have blotted them all out.

"Men living in a continent so cut up by Mediterranean Seas as Europe, can hardly form a good idea of the past of America, in as far as commercial intercourse is concerned. Our antiquarians do not even seem aware of the extreme advantage the features of our continent must have lent to commerce in ancient times. I have alluded to this at the end of the Chapter, Ancient Civilization of the North (Smithsonian Report).

"Pretty good samples of *fishing nets* have been found in the stone age establishment of Robenhausen (Canton of Zürich), together with well-preserved bows (for shooting), made of the yew (*Taxus buccata*). Dig and dredge, and you will find!"

Dr. Le Conte denied the existence of evidences of a genuine copper or bronze age in America, the equivalent of the so-called copper or bronze age in Europe. The relics of copper found in the mounds are neither fused nor alloyed, but simply hammered, and belong, therefore, properly to the class of stone implements, native argentiferous copper being acci-

* The Cone of the Tiniere is a torrential dejection at the point where that stream enters Lake Leman at Villeneuve, and which was cut transversely by a railway excavation.

dentally one of the minerals at the command of the savages who built the mounds.

Dr. Roehrig presented a photographic likeness of Mirza Alexander Kasem Beg, a lately elected member of the Society, and the Librarian was requested to continue the collection of *cartes de visite* of the members.

The Finance Committee made their annual report, recommending two resolutions, which on motion were adopted, viz., the payment of the bill of C. Sherman & Son, for printing Vol. XII, Part II, of the Transactions, and the following appropriations for the ensuing year:

For Journals,	$50
Hall,	100
Binding,	100
Publications, in addition to the interest on the Publication Fund,	800
General account, salary of Librarian,	700
Salary of Janitor,	100
Insurance of Library and Cabinet in Hall, and paper at Sherman's,	165
Assistant Librarian,	360
Petty expenses of Librarian,	50
Commissions to Treasurer, &c. &c.,	600
Total appropriations,	$3025

Pending nominations Nos. 465 to 477, and new nominations Nos. 478, 479 were read.

The Senior Secretary made a verbal report that the Secretaries recommend the deposit of Mr. Breck's MS. in the Library among the MSS. of the Society.

And the Society was adjourned.

SURVIVING MEMBERS OF THE A. P. S.

Benjamin Silliman, New Haven.
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John Davis, Boston.
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Joseph G. Swift, New York.
Eugenius Nulty, Philadelphia.
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Titian R. Peale, Washington, D. C.
Franklin Peale, Philadelphia.
Samuel V. Merrick, "
Henry J. Williams, "
Henry D. Rogers, Glasgow, Scotland.
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John Torrey, New York City.
Joseph Henry, Washington, D. C.
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David Irvin, Wisconsin.
Adolph C. P. Callisen, Altona, Europe.
Benjamin Dorr, Philadelphia.
Tobias Wagner, "
Edward Sabine, Royal Army, England
Roswell Park, Wisconsin.
Robert Christison, Edinburg.
Edward Hitchcock, Amherst, Mass.

George Bancroft, New York City.
Baron de Roenne, Dresden.
E. Otis Kendall, Philadelphia.
Charles Lyell, London.
E. W. Brayley, "
D. Humphreys Storer, Boston.
Simeon Borden, "
Frederick Fraley, Philadelphia.
George Peacock, Cambridge, England.
J. I. Clark Hare, Philadelphia.
Benjamin Pierce, Cambridge, Mass.
Leopold II, Grand Duke of Tuscany.
Louis Agassiz, Cambridge, Mass.
William M. Gerhard, Philadelphia.
John Lenthall, Washington, D. C.
Solomon W. Roberts, Philadelphia.
Charles B. Trego, "
Charles Wilkes, U. S. N.
Stanislaus Julien, Paris.
John Downes, Springfield, Mass.
Theodore Strong, New Brnnswick, N. J.
Alfred L. Elwyn, Philadelphia.
Robert Bridges, "
John W. Draper, New York City.
W. A. Norton, New Haven, Conn.
Alonzo Potter, Philadelphia.
Roger B. Taney, Washington, D. C.
Jacob R. Eckfeldt, Philadelphia.
William E. Dubois, "
John C. Trautwine, "
John S. Hart, "
Samuel S. Haldeman, Columbia, Pa.
George W. Norris, Philadelphia.
Joseph Carson, Philadelphia.
Richard Owen, London.
Sir James Clark, "
Prince Maximilian, Wied.
James Copland, London.
William Tell Poussin, Paris.
Frederick von Raumer, Berlin.
Edward Miller, Philadelphia.
William B. Carpenter, London.
Sir William Jardin, Scotland.
Professor Lepsius, Berlin.
Henry Holland, London.
James Buchanan, Lancaster.
Lewis Waln, Philadelphia.
Richard S. McCulloh, Philadelphia.
Ceva Grimaldi, Marquis, Naples.
A. T. Kupffer, St. Petersburg.
U. J. Leverrier, Paris.
Richard A. Tilghman, Philadelphia.
William Procter, Jr., "
John F. James, "
Robert Baird, New York.
J. Melville Gilliss, Washington, D. C.
J. C. Adams, Cambridge, England.
Asa Gray, Cambridge, Mass.
Gustav Adolph Jahn, Leipsig.
William L. Storrs, Connecticut.
Alexander H. Stevens, New York.
Ralph J. Ingersoll, New Haven, Conn.
John N. Conyngham, Luzerne Co., Pa.
E. Geddings, South Carolina.
F. A. Pouchet, Rouen.
Miers Fisher Longstreth, Del. Co., Pa.
Samuel F. B. Morse, New York City.
E. N. Horsford, Cambridge, Mass.
George P. Marsh, Vermont.
John Goodsir, Edinburgh, Scotland.
John Hughes Bennett, Scotland.
Francis Kiernan, London.
A. A. Gould, Boston, Mass.
Joseph Leidy, Philadelphia.
W. S. W. Ruschenberger, U. S. N.
Stephen Colwell, Philadelphia.
John H. Towne, "
Charles M. Wetherill, Washington, D. C.
Thomas S. Kirkbride, Philadelphia.
Benjamin A. Gould, Jr., Camb., Mass.
George M. Totten, Panama.
Joseph W. Farnum, New York city.
William Pepper, Philadelphia.
Peter McCall, "
Joseph Pancoast, "
Robert Patterson, "
Fran. Cav. Zantedeschi, Padua.
Daniel Kirkwood, Bloomington, Ind.
William Chauvenet, St. Louis, Mo.
George Sharswood, Philadelphia.
James Dundas, "
Francis Gurney Smith, "
John Forsyth Meigs, "
Edward King, "
Charles Henry Davis, U. S. N.
Michael Chevalier, Paris.
Alfred Stillé, Philadelphia.
John Neill, "
J. S. Hubbard, Washington, D. C.
Thomas B. Wilson, Philadelphia.
John Cassin, "
John H. Alexander, Baltimore.
J. Liouville, Paris.
John L. Le Conte, Philadelphia.
Edward E. Law, "
John P. Kennedy, Baltimore.
Alfred Mordecai, U. S. A.
Thomas L. Patterson.
Henry Grinnell, New York City.
John B. Biddle, Philadelphia.
Alex. Fischer von Waldheim, Moscow.
Basile Sakharoff, St. Petersburg.
Peter Strelkowsky, "
Charles Dworjak, "
Fr. Geo. Wm. de Struve, "
Charles D. Arfwedson, Stockholm.
James Paget, London.
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John H. B. Latrobe, Baltimore.
Mont. C. Meigs, Washington, D. C.
Benjamin Hollowell, Alexandria, Va.
George Harding, Philadelphia.
Francis West, "
Frederick A. Genth, "
George A. McCall, "
Samuel M. Felton, "
Samuel D. Gross, "
Charles Renard, Moscow.
C. A. Dohrn, Stettin.
William Bacon Stevens, Philadelphia.
Benjamin Gerhard, "

Elias Durand, Philadelphia.
William V. Keating, "
Joshua J. Cohen, Baltimore.
Lord Mahon, England.
James Lenox, New York City.
Eli K. Price, Philadelphia.
Constant Guillou, "
James D. Dana, New Haven, Conn.
Oliver Wolcott Gibbs, New York.
James Hall, Albany.
William Parker Foulke, Philadelphia.
Spencer F. Baird, Washington, D. C.
C. Fr. Ph. von Martius, Munich.
William Haidinger, Vienna.
V. Regnault, Paris.
Samuel Powel, Philadelphia.
Elisha J. Lewis, "
E. P. Rogers, Albany, N. Y.
Robert E. Rogers, Philadelphia.
Albert Barnes, "
Henry Coppée, "
George Allen, "
Strickland Kneass, "
Henry William Field, London.
John P. Brown, Constantinople.
Geo. Augustus Matile, New York City.
Thomas L. Kane, Philadelphia.
William B. Reed, "
Clement A. Finley, U. S. A.
Albert S. Letchworth, Philadelphia.
Theo. Lacordaire, Liege.
Hermann Burmeister, Halle.
Samuel L. Hollingsworth, Philadelphia.
Christian Olrik, Copenhagen.
John C. Adamson, Cape Town, Africa.
J. Peter Lesley, Philadelphia.
John Leyburn, "
Hugh Blair Grigsby, Virginia.
Robert P. Harris, Philadelphia.
Thomas F. Betton, Germantown.
Theodore Cuyler, Philadelphia.
Thomas P. James, "
Nathaniel P. Shurtleff, Boston.
Fairman Rogers, Philadelphia.
B. Howard Rand, "
Charles M. Cresson, "
Kingston Goddard, "
J. Lawrence Smith, Louisville, Ky.
E. Spencer Miller, Philadelphia.
Andrew A. Humphreys, U. S. T. E.
Elia Lombardini, Milan.
Henry C. Wayne, U. S. A.
William H. Allen, Philadelphia.
William M. Uhler, "
Charles E. Smith, "
Edward Hartshorne, "
Oswald Thompson, "
Edmund C. Evans, Chester County, Pa.
Casper Wister, Philadelphia.
Walter H. Lowrie, Pittsburg.
William S. Vaux, Philadelphia.
William R. Palmer, U. S. T. E.
Samuel H. Dickson, Philadelphia.
Henry Carleton, "
William A. Hammond, U. S. A.
P. Angelo Secchi, Rome.
Aubrey H. Smith, Philadelphia.
Francis W. Lewis, "
Francis V. Hayden, "
Sidney George Fisher, "
Sir Roderick I. Murchison, London.
Adam Sedgewick, "
Leonce Elie de Beaumont, Paris.
Henry Milne Edwards, "
Theo. L. W. Bischoff, München.
Herm. von Meyer, Frankfort-on-Main.
Andreas Wagner, München.
Joseph Hyrtl, Vienna.
Sir William Logan, Montreal.
Heinrich Rose, Berlin.
George Jäger, Stuttgard.
St. Claire Deville, Paris.
William H. Harvey, Dublin.
Jean Baptiste Dumas, Paris.
Edouard Verneuil, "
Claude Bernard, "
Daniel R. Goodwin, Philadelphia.
Leo Lesquereux, Columbus, Ohio.
John Lothrop Motley, Providence, R. I.
Pasqual de Guyangos, Madrid.
John Curwen, Harrisburg, Pa.
Charles Des Moulins, Bordeaux.
Thomas Sterry Hunt, Montreal.
Paolo Volpicelli, Rome.
Alexander Kasem Beg, St. Petersburg.
Otto Boehtlingk, "
G. Forchammer, Copenhagen.
J. S. Steenstrup, "
C. J. Thomsen, "
Andrew C. Ramsay, England.
Edouard Desor, Neuchâtel.
L. G. de Koninck, Liège.
Joachim Barrande, Prague.
Robert W. Bunsen, Heidelburg.
William Hofmann, London.
H. R. Göppert, Breslau.
Alexander Braun, Leipsig.
William J. Hamilton, London.
Sir William J. Hooker, "
J. J. Kaup, Darmstadt.
J. A. Froude, Oxford, Eng.
Hermann Lebert, Breslau.
S. Weir Mitchell, Philadelphia.
F. L. Otto Roehrig, "
H. L. Abbot, U. S. T. E.
Oswald Heer, Zurich.
John Lindley, London.
J. von Liebig, München.
Frederick Wöhler, Göttingen.
James W. Dawson, Montreal.
Samuel F. Dupont, U. S. N.
George Engelmann, St. Louis.
Wm. S. Sullivant, Columbus, Ohio.
Evan Pugh, Centre County, Pa.
Andrew A. Henderson, U. S. N.
Robert Cornelius, Philadelphia.
Rudolf Virchow, Berlin.
Fr. Theo. Frerichs, Berlin.
Thomas J. Lee, Maryland.
Louis Stromeyer, Hanover.
Karl Rokitansky, Vienna.
Henry Winsor, Philadelphia.

In all, 392.

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY.

VOL. IX. JANUARY, 1863. No. 69.

Stated Meeting, January 2, 1863.

Present, fourteen members.

Dr. WOOD, President, in the Chair.

Letters acknowledging the receipt of publications were received from the American Oriental Society, dated December 27th, and from the Smithsonian Institution, dated April 25th, 1862.

A letter was received from M. d'Hericourt, dated Rue Royer-Collard, No. 9, Paris, December 15th, respecting reviews.

Donations for the Library were received from the British Association, the Royal Astronomical, Royal Geographical and Geological Societies, and Society of Arts in London, the Historical and Literary Society in Quebec, the Academies at Boston and Philadelphia, Dr. George B. Wood, Dr. Edward Jarvis of Dorchester, and Thomas E. Blackwell, Esq., of London.

The death of Col. Charles Ellet, at Cairo, Illinois, June 21st, 1862, a member of the Society, was announced by the Secretary.

Dr. Wood, the President, presented to the Society a mar-

ble bust of Franklin, on a cylindrical pedestal of dark scagliola. Dr. Wood gave the order to an artist of Florence, M. Manconi, to execute this life-size reduction in marble of a colossal plaster bust of Franklin, in the private collection of Mr. Packingham in Florence, which was ascribed to Houdon.

On motion of Prof. Cresson, the thanks of the Society were presented to Dr. Wood, for his munificent donation.

The judges and clerks of the election reported the appointment of the following officers:

President.

George B. Wood.

Vice-Presidents.

John C. Cresson,
Isaac Lea,
George Sharswood.

Secretaries.

Charles B. Trego,
E. Otis Kendall,
John L. Le Conte,
Peter Lesley.

Counsellors for Three Years.

Frederick Fraley,
Robert Patterson,
Daniel R. Goodwin,
William Parker Foulke.

Curators.

Franklin Peale,
Elias Durand,
Joseph Carson.

Treasurer.

Charles B. Trego.

On motion of Mr. Fraley, Prof. Lesley was nominated Librarian for the ensuing year.

Pending nominations Nos. 465 to 480, and new nominations Nos. 481, 482, were read.

On motion of the Librarian, the Zoological Society at Frankfort, and the University of Bonn were ordered to be placed on the list of correspondents to receive the Proceedings, and the Observatory of Prague, and the Geological Bureau of the Government of India, to receive the Transactions and Proceedings,—the former as complete a set as possible, in exchange for their Observations.

Prof. Cresson referred to a previous discussion on electrical phenomena, and described in his opinion the best method of regarding the inductive agency of electricity, in preparing its own path before it.

Dr. Wood described a new steam boiler exhibited in England by its inventor, Mr. Harrison, of Philadelphia, who has overcome, as he supposes, the difficulties which were encountered when the boiler was first tried in the workshops of the Messrs. Sellers, of Philadelphia, a year or two ago. The boiler is made up of numerous hollow cast-iron dumb bells, and can be taken to pieces for transportation over difficult ground. It has stood 400 pounds of pressure to the inch.

The Society was then adjourned.

Stated Meeting, January 16, 1863.

Present, eighteen members.

Dr. Wood, President, in the Chair.

Letters acknowledging publications received were read from Sir John Herschel, Collingwood, December 2d; the Royal Horticultural Society, South Kensington, W., December 10th; the Admiralty, November 29th; the Natural History Society of Northumberland, Newcastle, December 11th, and the Royal Society, Göttingen, October 15th, 1862.

Letters announcing donations were received from the Royal Society at Göttingen, October 15th; the Royal Prussian Academy, Berlin, August 15th; the P. Jablonowski Society at Leipsic, September 25th; the Royal Saxon Society, July 31st and August 15th; the Upper Lausatian Society at Görlitz, September 29th; the Mineralogical Society at St. Petersburg, September 10th, and the Imperial Society of Naturalists at Moscow, February 15th, 1862; also from the Royal Physico-Economical Society at Königsberg, May 6th, and the Munich Academy, May 24th, 1861.

A second letter was read, addressed to the President, from Count d'Hericourt, Paris, November 15th, 1862, respecting his new review.

A letter from N. Trübner & Co., respecting future correspondence, was received, dated London, December 19th, 1862.

Donations for the Library were announced from the learned Academies and Societies at St. Petersburg, Moscow, Königsberg, Berlin, Leipsic, Göttingen, Munich, Görlitz, Mannheim, Emden, Haarlem, and Dijon; M. Des Moulins at Bordeaux; Hon. James Pollock, Philadelphia; Blanchard & Lea; Prof. Evan Pugh; Mr. Thomas U. Walter, of Washington, and the Superintendents of the United States Coast Survey and Nautical Observatory.

Dr. Bache announced the death of Prof. James Renwick, January 12th, 1863, at New York, aged 70.

On motion of Mr. Fraley, Prof. Lesley was elected Librarian for the ensuing year.

On motion, the following Standing Committees were chosen:

Committee on Finance.—Mr. Fraley, Mr. J. F. James, Mr. Samuel Powel.

Committee on Publication.—Dr. Bridges, Mr. T. P. James, Dr. Hartshorne, Prof. Coppée, Dr. Wister.

Committee on Hall.—Mr. Peale, Judge King, Prof. Coppée.

Committee on Library.—Dr. Bell, Dr. Stevens, Dr. Coates, Mr. Price, Mr. Barnes.

The list of surviving members was read, and corrected by

the announcement of the death of Captain W. R. Palmer, U. S. T. E.

Summary.

On the List, Jan. 1, 1862, . .	374.	U. S.,	256,	Foreign,	118
Elected in 1862, ...		U. S.,	11,	"	27
Deceased reported in 1862, . . .		U. S.,	10,	"	9
Expelled in 1862, ...		U. S.,	2.		
Number of members, Dec. 31, 1862, ...	391.	U. S.,	255,	"	136

Pending nominations, Nos. 465 to 482 were read.

The ballotting for members then proceeded.

The following resolutions of the Library Committee were read, and consideration thereof postponed to the next meeting, on account of the lateness of the hour.

"*Resolved,* That this Committee recommend to the Society, to distribute the Catalogue, as far as printed, to foreign correspondents.

" *Resolved,* That this Committee recommend to the Society, to distribute copies of the portion of the Catalogue now printed to subscribers to the whole Catalogue."

No other business being before the meeting, the ballot-boxes were opened, and the following persons were declared duly elected members of the Society.

Dr. James Y. Simpson, of Edinburgh.
Dr. Thèodore Schwann, of Liège.
Dr. Jacques L. Grimm, of Berlin.
Prof. Franz Bopp, of Berlin.
Prof. Ernest Renan, of Paris.
Prof. Max Müller, of Cambridge.
Prof. J. D. Whitney, of San Francisco.
Prof. A. H. Worthen, of Springfield, Ill.
Prof. Daniel Wilson, of Toronto, C. W.
Prof. Frederick Troyon, of Lausanne.
M. Boucher de Perthes, of Abbeville.
Mr. Pliny E. Chase, of Philadelphia.
Dr. I. I. Hayes, Supt. U. S. Hospital, West Phila.
Dr. George Smith, of Delaware County, Pa.

Hon. John M. Read, of Philadelphia.
Dr. Edward Jarvis, of Dorchester, Mass.

And the Society was thereupon adjourned.

Stated Meeting, February 6, 1863.

Present, twenty-one members.

Dr. Wood, President, in the Chair.

Mr. Pliny E. Chase, a newly-elected member, was introduced to the President, and took his seat.

Letters accepting membership were read from the Hon. John M. Read, of Philadelphia, January 19th; from Dr. Edward Jarvis, Dorchester, Mass., January 20th; from Mr. A. H. Worthen, Springfield, Ill., January 21st; from Prof. Daniel Wilson, University College, Toronto, C. W., January 22d, and from Dr. George Smith, Upper Darby, Delaware County, Pa., January 22d, 1863.

Letters acknowledging publications were received from the Radcliffe Observatory, Oxford, November 28th, 1861; from the Society of Antiquaries, London, January 9th, 1862, and from the Historical Society of Pennsylvania, Philadelphia, January 20th, 1863.

Donations to the Library were received from the Ober-Commando of the Austrian Marine; the Royal, Royal Astronomical, Royal Asiatic, and Chemical Societies, in London; the Royal Observatory at Greenwich; Prof. De Morgan and Prof. Daubeny, of Oxford; the Boston Natural History Society; Silliman's Journal; the Franklin Institute, and Prof. Schaeffer; the Superintendents of the Coast Survey and Census Bureau, and Captain Abbot, of the U. S. Top. Engs.

Prof. Trego announced the death of Col. J. J. Abert, U. S. Top. Engs., January 27th, 1863, in the seventy-fifth year of his age.

Dr. Bache presented a written communication from Judge Carleton, which embodied the views expressed by him in previous discussions of the subject, as follows:

LIBERTY AND NECESSITY.

On both sides of this question authors agree that the Will is the immediate antecedent to action. The Arminians say it is a free, self-acting power; the Necessarians, that it is actuated by the strongest motive or judgment of the mind.

The controversy has been kept up for more than twenty centuries, although it turns solely upon facts within every man's daily experience.

LIBERTY.

The most approved definition of a free, self-acting Will, is that given by a Professor in an American University, as follows: "The Will is a cause contingent and free,—is first cause itself. Acts of the Will neither require nor admit of antecedent causes to explain their action. What moves the Will to go in the direction of reason? Nothing moves it; it is cause *per se*. It goes in that direction because it has power to go in that direction. What moves the Will to go in the direction of the sensitivity? Nothing moves it; it is cause *per se*. It goes in that direction because it has power to go in that direction. It is a power that is indifferent to the agreeableness or disagreeableness of objects. Distinct from reason, it is not conviction or belief."

The Professor is an eminent divine, the author of an elaborate work on the mind, in which we find the above definition of the Will.

When asked what moves him to pray and preach, he explains himself,—Nothing moves him to pray and preach; his Will moves itself. He prays and preaches because he is able to pray and preach. What moves him to eat and drink when hungry and thirsty? Nothing moves him; his Will moves itself. It neither requires nor admits of antecedent causes to explain its actions, and if it moved not of itself, the Professor might die of hunger or thirst.

That motion can begin of itself is purely a fiction, contrived to bolster up a senseless system of free agency, that sinks the mind below the instinct of brutes. The understanding was given to man, as his protection in the mixed state of good and evil in which he is placed. Without its guidance, his lawless will, if there be such an agent, would hurry him indiscriminately upon good or evil, without the power of choice or resistance.

Nevertheless, the late Sir William Hamilton is of opinion, that all

freedom of action would be destroyed, if controlled by the influence of motive. He says: "The determination of the Will by motive cannot, to our understanding, escape necessitation. How the Will can possibly be free, must remain to us under the present limitation of our faculties, wholly incomprehensible. How moral liberty is possible in man or God, we are utterly unable speculatively to understand, but practically the fact that we are free, is given in the consciousness of an uncompromising law of duty."

Descartes also thought that the solution of the question was beyond the reach of the human faculties. Mallebranche and Berkeley got over the difficulty by resolving every determination of the Will into the act of God. But a Professor in the University of Virginia, a strenuous advocate of free will, affirms that the Will is not determined at all. "It simply determines;" "is the determiner;" "that a Will controlled by motive is no Will at all;" "a caused volition is no volition." It is certainly true that a Will, controlled by motive, does not control itself, is not free.

Nevertheless every one is conscious, as is the Professor himself, that he acts under the control of some motive or determination of his mind, and that, when under no external restraint, his actions are always such as he intended they should be, as they certainly were when he committed the foregoing opinion to writing.

It is a waste of time to contend with those who are conscious that they are in the wrong. In all prosecutions for offences, the guilt or innocence of the accused turns upon the motive with which the act was done. No man can know his motive so well as the agent himself. He acts as he thinks; and as he thinks, so is he innocent or guilty. Actions must vary with motives, and hence the diversity of pursuit among mankind. Nevertheless, philosophers have labored two thousand years to show there is but one uniform cause of action, a free, self-acting Will, which they do not pretend can have any judgment, opinion, or motive of its own, and is yet independent of the motives of that mind of which it forms a part. Of all the aberrations of the human intellect, this is the most absurd. To such extremities are certain writers driven, to uphold their lawless system of free agency, lest it should be argued that if man be a necessary agent, God who made him so would be the author of all the sin and moral evil that afflicts our race.

But if, as some divines insist, all moral and physical evils were visited by act of God upon man, because of the sin of Adam; then the origin of evil is known, and no question can arise, or ought ever to have arisen about it.

But as we have no right to suppose that other evils than those mentioned in Scripture were visited upon the guilty pair, whence then came earthquakes, volcanoes, tempests, inundations, or commotions of the air, that have destroyed such multitudes of mankind? or whence came revenge, hate, malice, ambition, and lust, that have reddened the earth with the blood of her children, or the diseases, sufferings, and death of infants that have never sinned, or the oppressions of the weak by the strong, or the miseries of all living things that suffer from the sport and tyranny of men, whose all-devouring stomachs call for a daily sacrifice of millions at a meal?

It was the sovereign pleasure of the Deity to create different orders of imperfect beings from the insect up to man, all subject alike to suffering, disease, and death, and to place them on a globe, the imperfections of which are of a piece with their own. The existence of good and evil comes from the same Power, whose pleasure it was to create all things as they are.

It borders on blasphemy to argue that God could be the author of sin in any form. Sin is the transgression of a rule of conduct prescribed to man. God cannot sin. He cannot make graven images of Himself, honor His father or mother, or bear false witness against His neighbor. He knows no law but His own good pleasure. When He cuts off thousands by pestilence, wars, or earthquakes, He violates no law. He is a law unto Himself; there is no standard above Him.

NECESSITY.

It is a grievous evil that a question of fact, as is that of Liberty and Necessity, should remain unsettled after a controversy of more than two thousand years. The reason is plain. Unable to conceive how a determination of the mind could be the immediate cause of action, philosophers have invented a power they call the Will, which they imagined might actuate a man as the spring does the machinery of a watch, or the weights that of a clock.

This fiction is made the basis of every treatise on the mind, according as the writer shall espouse the side of Liberty or Necessity. One great truth, however, has been wrought out of this controversy by President Edwards, who has shown, beyond the possibility of a doubt, that all actions arise from "the perception of the greatest apparent good by a law of our nature, which we could not resist if we would, and would not if we could."

But that acute logician, yielding to the prejudice of the age,

thought that the determination of the mind could not of itself move a leg or an arm, without the concurrent agency of the Will, making two causes necessary to produce one effect, contrary to all the known laws of nature, wherein many effects are produced from a single cause. The fall of bodies, the motion of fluids, and the fluxes of the tides come of gravitation alone. Heat warms our blood, cooks our food, melts brass, expands the air, raises clouds, reanimates plants, clothes them with leaves, and the earth with verdure. The atmosphere is the vehicle of sound and respiration, causes twilight, morning, and evening, and scatters decaying substances upon the winds. Sir Isaac Newton has said: "More causes of natural things are not to be admitted than are necessary to explain the phenomena; for nature is simple, and does nothing in vain." While the Necessarians require two causes to one effect, the Arminians require only one Will that acts of itself. The mind, by its own energy, is the real cause of action; there is no such intermediate agent as the Will. If philosophers cannot understand how the mind can be the cause of action, how can they conceive the Will to be the cause? much less can they conceive the double agency of the Will, first to move itself, and then to move the man. That the mind is the immediate cause of action, is a fact of every man's own experience; for if actuated by any other cause, he would know it as he knows he hears with his ears, and sees with his eyes.

If metaphysicians earnestly seek the truth, they must condescend to men of low estate, who obey the teachings of simple nature unsophisticated by the speculations of philosophy. The most illiterate mechanic possesses within himself all that can be known of the human mind.

Ask a ploughman why he eats and drinks, he will reply, "To satisfy hunger and thirst." His answer is just and complete. Put the same question to a philosopher. He too will reply, "To satisfy hunger and thirst." But the ploughman acts directly under the impulse of his wants; while the philosopher's motive must first move the Will to move the man before he can eat or drink. The ploughman is conscious that his desire is the sole motive power. He knows of no such agent within him as the Will; whereas, the philosopher's desire cannot move him unless through the circuit of his Will.

According to the theory of the Necessarians, when a man walks a mile, he must repeat the operation of *motive, volition, action*, seventeen hundred and sixty times; *motive, volition, action*, the right foot, *motive, volition, action*, the left foot; and whatever else he may

do or say on the way will require the repetition of the same process, *motive, volition, action.*

THE WILL.

All controversies on Liberty and Necessity are made to turn upon the supposed powers of the Will.

Locke says the only object of the Will is some action of ours, nothing more.

Mallebranche thinks it is the province of the Will to reason.

Bielfield, that its quality is that of determining.

Hume, a power by which new actions and thoughts are produced.

Cousin resolves it into attention, consciousness, or measure of time, and says it can act against motive.

Edwards says: "The very act of volition itself is doubtless a determination of the mind," and that it does not differ from the affections.

Luther, that the foreknowledge of God is a thunderbolt that strikes free will into atoms.

Calvin thinks that volitions, as well as all other events, come to pass by the decrees of God.

Hobbs, Collins, and Edwards think they are necessitated by motives.

Reed and Clarke say the Will is the last determination of the mind.

Stewart says that it has no power over thought.

Gall and Spurzheim affirm it is merely the decision of the understanding.

Dr. Brown seems to identify it with desire.

Payne and Young are inclined to the same opinion.

Morrell says it is a spontaneity, or self-acting power.

Spinoza, that free will is a dream, a vulgar prejudice.

Descartes thinks that the Will is free, but cannot tell how.

Leibnitz held to necessity, in virtue of a pre-established harmony.

A hundred other instances might be adduced, from which it would appear that no two writers agree in their definition of the Will. The reason is plain. Its agency being purely imaginary, they take care to invest it with attributes to suit their respective theories; as writers of romance adapt their actors to the part they have to play.

The Will has proved a prolific source of bookmaking to metaphysicians. It is their darling theme, unexhausted and inexhaustible to

the end of time. Every year, almost every month, the press teems with romances on the Will, which are seldom read, never believed, and soon drop into oblivion. Other sciences are consistent, because founded in fact; but in mental philosophy the writer is never for two consecutive pages in harmony with himself.

The word *Will* is borrowed from the Scriptures, but diverted from its appropriate meaning. The Will of God is His pleasure, or whatever is agreeable to Him. "Thy will be done on earth as it is in heaven," is not a prayer for the exercise of His power, but that we may do His pleasure on earth as it is done in heaven. Again: "It is not every one that saith Lord, Lord, shall enter the kingdom of heaven, but he that doeth the *Will* of my Father, which is in heaven." That the word here means whatever is pleasing to God, cannot admit of a doubt, nor can it be made to have any other meaning throughout the whole body of the Scriptures.

Such is the sense, also, in which it is used in common speech among men. "If it be the Will of God, I shall reach home in safety," or "that I shall live until my son arrive from Europe." "God willing, the Sacrament will be administered in this church next sabbath."

So every man's will means his pleasure. To one you say, "What is your will, sir?" "To know if you are willing to take the price I offered you for your house." "No, I am not willing." To another, "What is your will, sir?" "To borrow Scott's Commentary." To a third, "What is your will, sir?" "To request you to send this letter to Liverpool."

The dynamic power of the Will is altogether a fiction. It is simply a passive capacity to receive pleasure, from whatever affects us agreeably at the time. An attribute is not an agent.

CAUSES OF ACTION.

Like all things else under the sun, the mind is passive, until aroused by its appropriate causes, sensations, and ideas. It is necessarily passive to all sensations before they are perceived, or to truths in science before they are known.

When not occupied by causes without, it is held in perpetual excitement by its own unceasing trains of thought, a fact that has deceived philosophers into a belief that the mind was an active principle in itself and never at rest; while all sound sleepers know that,

like the body, it has its periods of perfect repose. It is only when awake that it has dominion over the body by its own immediate energy, and never through the circuit of an imaginary Will. It is not the body but the mind that makes the man. As he thinks, so is he wise or foolish, good or bad, sinner or saint, Jew or Gentile, Pagan, Mahomedan, or Christian. The mind is the direct and sole dynamic power in man, and does not admit of any other cause of action than itself. It is single, not double; does not consist of one faculty to decree, and another, the Will, to execute its decrees; "for nature is simple, and does nothing in vain." It never employs two causes for one effect; on the contrary, it produces many effects from one cause.

Whatever comes to pass in the external world, or in the mind, must be attested by consciousness, the source of all knowledge, or it cannot be known. The existence of anger, hatred, love, remorse, motive, and all other mental phenomena, are as truly facts, as the death of a man or the birth of a child; and every one knows from his own consciousness, that they are the direct and immediate causes of action. In our most quiet moods, they rise to the surface, and betray the workings of the spirit within. We are by turns sad, soothed, gay, inflamed; we blush, or grow pale, by the mere power of thought. We are convulsed with laughter at a flash of wit; eyes, mouth, nose, chin, and cheeks, all partake of the perturbation, but instantly react at the sight of distress. Hope disappointed, mortification, remorse, sorrow, grief, the forebodings of evil that never happens, disturb the mind, and emaciate the frame. The first convulsive movement in a camp meeting gives rise to a second. The idea exists, and the effects follow. Boërhaave threatened to burn with a hot iron the next man in his hospital taken with St. Vitus's dance; and the fear of punishment prevented the recurrence of the evil. Von Sweiten relates of himself, that he passed near where a dead dog had burst from putrefaction; the stench made him vomit. Three years thereafter he passed the same spot, when the recollection of the offensive object made him vomit again. A blacksmith at his anvil was told he had drawn thirty thousand pounds in a lottery; the hammer fell from his hand, and he became a maniac for life! The news of a sudden calamity will often overthrow the reason as effectually as a fracture of the skull from a blow. A child will shed tears at a tale of fictitious woe, and the rudest nature will surrender to emotions of pity at the complicated miseries of a tragic scene. The

bereft mother weeps at the thought of her departed child. When the thought is not present, her tears cease to flow.

That actions in all the above cases do proceed from the mind as the immediate cause, and not from the Will, are matters of fact attested by our own consciousness, from which there is no appeal.

Again: the passions, whether natural or acquired, play their part in the drama of life. Says an elegant writer: "The passions are the winds by which we sail, and, though they may upset our ship, we cannot sail without them." That their power over the mind, when excessive, often hurries us into deeds of violence, are facts that nobody will deny.

The motive power in man that absorbs all others, is the desire of happiness, that "light and glory of the world." Though he knows it is unattainable on earth, he does not relax his pursuit on that account. It is a necessity of his nature, that he should continue to hope, to act, and to be deceived until he dies. If he obtain his object, it often proves his destruction. He pursues what his judgment approves, and, though he may err, it is the only guide Providence has vouchsafed to bestow.

M. Cousin affirms, that "at the moment the Will exerts itself in a special act we are conscious it could exert itself in a special act totally contrary, without any obstacle, without being thereby exhausted; so that having changed its acts a hundred times, the faculty remains integrally the same, being always able to do what it does not, and always able to do what it does. Here then, in all its plenitude, is the characteristic of Liberty." That is to say, the Will can act of itself, without or against motive, and for the truth of this fact, that philosopher takes refuge behind his own consciousness, where he knows he cannot be reached. No man is conscious of what he cannot know. Consciousness is knowledge. He is conscious of what he once did, or is now doing, but never of innate powers of mind before they are brought out by experience. Milton and Pope were not conscious they were born poets before put to the trial. Revolutions often bring to light powers before unknown to the possessors themselves.

M. Cousin's doctrine can never be tested by experiment; since it is impossible to act without motive or against motive. While going to the east under a prevailing purpose, it is plain he could not turn his steps to the west, unless actuated by a contrary and stronger motive. Yet this same delusion is the besetting evil of all who write or speak on the subject of the Will. When they appeal to their

consciousness, they mean, if they understand themselves, that they could do the contrary, under the influence of a contrary motive, and not without.

He is a free agent who does as he prefers; a higher degree of freedom cannot exist. If he commit a crime, he does as he prefers; if he abstain, this also is as he prefers. His perception of the greatest apparent good is the sole and direct spring of action, as inseparable from his being as gravitation from matter. It is impossible he should prefer pain to pleasure. It is a necessity of his nature that he should do what he prefers. When he swallows a nauseous drug, or undergoes the amputation of a limb, his motive is not the drug or amputation; he suffers a present evil from the hope of a remote and greater good. In this he is a free agent, and acts as he prefers; he cannot act otherwise.

It is now plain that Liberty and Necessity, or free agency, can be affirmed of actions only, and never of the mind, whose thoughts are governed by laws beyond the reach of outward force.

Motive is but the preference of the mind for one action rather than another, and if a man can do what he prefers he is a free agent, but ceases to be so, as soon as put under external restraint. Free agency is freedom from external restraint; necessity is restraint by external force. A bonfire may be made of all books written on Liberty and Necessity; as everybody knows, from childhood upwards, when he is at liberty, or when he is prevented from doing what he pleases.

Mr. Foulke exhibited a box of phantom leaves dissected entirely by insects, and in a very perfect manner.

Mr. Foulke also exhibited articles of bijouterie made of woods and minerals from the Arctic regions, brought by the last Grinnell Expedition under Dr. Hayes.

Mr. Chase exhibited an alabaster cube or die, about seven-tenths of an inch square, picked up by a traveller from the floor of a Chinese temple, the angles and edges worn smooth, and on two opposite faces two inscriptions, the other four faces being plain. On one face the inscriptions read TA SIN SHAN TANG, four characters, occupying four quadrants within an octagon, and meaning Great Heart, Mountain Temple (or Mountain Plain).* The letters were in plain raised

* The character Tang has various meanings; "a palace; a temple; a hall; a wide level place on a mountain; high; dignified; illustrious," &c. It is per-

ridges, and of modern form. On the reverse, in one square area with raised sides, stand two tall, thin, antique characters, side by side, of the form called Chuen Shoo, or Seal-letter, which are read LEIH CHAE, meaning "perfectly in order."

The four modern letters, besides their general significance, are also embraced in the list of about four hundred characters which are employed in proper names. The cube, therefore, probably belonged to Mr. Ta-Sin (or Mr. Great Heart), of Shan-Tang, by whom it may have been employed as a Hong seal. It is the custom of Chinese merchants, to keep private seals of such a description, with which, aided by a sponge saturated with India ink or vermilion, they stamp their notes and other documents, as an additional evidence of genuineness.

The seal is especially interesting, in consequence of the precise resemblance in form between the character Shan, and the Chaldaic Shin (ש). This resemblance was pointed out in the remarks on "Chinese and Indo-European Roots and Analogues" (see Proceedings Am. Phil. Soc., volume for 1861), but in the ordinary mode of writing Shan, there is a downward stroke at the right hand, which is wanting in ש. It is also wanting on the seal.

The belief in the hieroglyphic origin of our alphabet has many weighty arguments to sustain it. The interest excited by the works of Young and Champollion, naturally directed the attention of archæologists to the monuments and papyri of Egypt, and encouraged the hope that among the various hieroglyphic, hieratic, and enchorial forms, the key to our own letters might be found. Many curious resemblances were pointed out, but none so decisive as to command universal assent.

M. de Guignes, in a memoir read before the Academy of Belles-Lettres in 1758, called attention to the syllabic characters of the Chinese, many of which can be readily traced to their hieroglyphic originals, while some are used in a peculiar quasi-alphabetic manner.

haps etymologically connected with the Indo-European root, Tan or Tang, "to extend; to spread." Shan-Tang is probably a city situated on an elevated table-land.—The woodcut represents the stamp-mark of the seal.

But he was so imbued with a belief in the greater antiquity of Egyptian civilization, that he supposed China to have been settled by an Egyptian colony, and its writings to have been borrowed from Egypt,—inferences that were not well sustained, and his arguments were therefore generally discredited. Nevertheless, his memoir is well worthy of perusal, and the coincidences (if they are nothing more), that he has ingeniously pointed out, are such as to stimulate curiosity.

The Roman, Greek, Samaritan, Phenician, and ancient Hebrew alphabets, all bear unmistakable evidence of a common origin. The modern Hebrew, which was borrowed from the Chaldaic, although different in most of its forms, still presents a marked affinity to the others in the number, arrangement, and names of its several letters, and in a traceable gradation of successive forms. The Hebrews, during their Egyptian bondage, may have modified their alphabet, and perhaps borrowed some additional letters, but is it probable that they were ignorant of writing before their captivity, or that we must look to the narrow valley of the Nile, for the origin not only of the civilization, but also of the monumental records of Europe and Asia? Does it not seem more reasonable to suppose that a more encouraging field for alphabetic investigation, may be found among a people that preserves the oldest extant type of civilization, still speaking a language and using hieroglyphic and alphabetic characters that have remained unchanged for more than two thousand years?*

Dr. Emerson made the following communication in relation to the African Imphee:

In a recent communication to this Society, I brought to its notice the introduction into Europe and the United States, of the *Sorghum Saccharatum*, or sugar-cane of the Northern provinces of China, referring to its great agricultural value, and its wonderful capacity to extend the sugar culture far beyond the tropical latitudes, to which and their immediate proximity, this valuable branch of industry has heretofore been limited in the Western World. The historical sketch

* The suggestive nature of Chinese writing, on which the natives pride themselves, is well illustrated by the first of the Chuen Shoo characters on the seal. The character appears to have been purposely shaped in such a way as to remind one of the three words Leih, "to establish or confirm,"—Chung, "truly,"—and Tsze, "self." The impression of the seal on any document, thus conveys the idea that it was stamped by the owner himself, to firmly establish the authenticity and validity of his signature.

of this extension of the sugar culture would be incomplete, without some account of the almost simultaneous introduction of another kind of cane derived from Africa, which for its sugar-making capacities, and other valuable purposes in extra-tropical situations, stands the rival of the Sorghum. I refer to the Imphee, or African sugar-cane.

The introduction of the Chinese Sorghum into the Western World appears to have been a somewhat fortuitous event. Not so, however, with that of the African cane, or Imphee, for which Europe and America stand indebted to the intelligence and well-directed enterprise of Mr. Leonard Wray, a professed sugar manufacturer, and author of books upon the subject. He informs us that whilst engaged in researches upon sugar-making, his mind became strongly impressed with the idea that "the reed," "the sweet reed," made such frequent mention of by ancient writers, as used by the natives of Morocco, Ethiopia, Egypt, Arabia, and India, for the purpose of making sugar, or jaggery, did not in all cases mean the tropical sugar-cane, but that some other reed-like plant was more probably referred to. Impelled by this impression, Mr. Wray at length determined to make explorations himself in Southern Africa, and for this purpose, left Calcutta in 1850 for the Cape of Good Hope. From thence he made a journey to Kaffirland, and in 1851, the very year that the seed of the Chinese Sorghum were sent from China by Count de Montigny, he found a species of cane, called by the Zulu Kaffirs Imphee. This he describes as a tall, slender, and very elegant plant, with light and graceful leaves, and tints bright and varied in different stages of its growth, exhaling a perfume strong and agreeable, somewhat resembling that of rich new honey.

Subsequently following up his researches, he sent out the most intelligent natives he could find, to collect seed of the different kinds of Imphee to be met with, and thus succeeded in obtaining no less than fifteen varieties of the plant, differing more or less from each other in external characters, saccharine richness, and periods of maturation. The several varieties of this family of plants, such as the Durra, Kaffir corn, or Guinea corn, are cultivated by the natives of different parts of Africa for their grain only, but Mr. Wray informs us, the Imphee is grown by the Kaffirs solely for its sweet juice, and never, to his knowledge, for its grain. They do not make from it either syrup or sugar, but content themselves with masticating and sucking the juice as an article of food. Mr. Wray tells us that it remains to be ascertained, whether we can, by adopting proper measures, obtain hybrids between the Imphee and sugar-cane.

Having remained long enough at Natal to ascertain the particular habits of his fifteen varieties, to each of which he has given its Kaffir name, and also to make sugar from them all, he left for Europe to prosecute further experiments, and introduce to the notice of the civilized world, the vast importance of his Imphee plants for sugar-making. He had patches of these planted in England, France, and Belgium. Since then, the culture has been extended by his efforts to Turkey, Egypt, the West Indies, Brazil, and other distant countries. In the United States, some have preferred the Chinese, others the African cane. Whilst the Imphee may be well adapted to certain localities, there can, I think, be little doubt of the superior value of the Chinese Sorghum for general cultivation in our Middle, Western, and Northern States.

Mr. Wray frankly tells us, that in looking into various botanical works, he finds that attempts had been formerly made, by Signor Arderino and others, to introduce varieties of this plant into European cultivation, for the purpose of making sugar, but from some cause or other, all their efforts had proved unsuccessful. These failures he ascribes to want of knowledge of the kinds of Imphee best adapted to the purpose, and want of skill to properly treat the juice.

In the course of the discussion which ensued, Mr. Fraley stated, on the authority of the Hon. Morris Davis, who was, in connection with Mr. Lovering, among the first to experiment on the Sorghum sugar manufacture, that the annual production of Sorghum syrup in the United States is already seventeen millions of gallons, equivalent to eighty-five millions of pounds of sugar; but the demand for the syrup is so great, that it bars for the present the sugar manufacture.

The recommendations of the Library Committee, postponed from the last meeting, were then briefly discussed, and on motion postponed to the next meeting.

Pending nominations Nos. 481, 482, and new nomination No. 483, were read.

And the Society was adjourned.

Stated Meeting, February 20, 1863.

Present, twenty-four members.

Dr. Wood, President, in the Chair.

A letter accepting membership, was received from Dr. I. I. Hayes, dated United States Army Hospital, West Philadelphia, February 2d, 1863, and afterwards Dr. Hayes was presented to the President, and took his seat.

Letters acknowledging the receipt of publications were received from the Literary and Historical Society of Quebec, dated February 9th, requesting also a set of the Transactions; the Corporation of Yale College, February 11th, and Harvard College, February 4th; the Connecticut and New Jersey Historical Societies, 25th and 11th; the New York State Library, February 9th; Captain Gilliss, National Observatory, February 3d, and the Chicago Historical Society, February 9th, 1863.

Donations for the Library were received from the Boston Natural History Society, Professor Hall, of Albany, the Chief Engineer of the Philadelphia Water Works, the Colonization Society, the Franklin Institute, the House of Refuge, the Deaf and Dumb Institution, through James J. Barclay, Esq., and the State Lunatic Hospital at Harrisburg.

The death of a member of the Society, Dr. Carl Ludwig Rümker, Director of the Hamburg Observatory, aged 74, was announced by the Secretary.

Mr. Chase, referring again to the Chinese Hong seal exhibited at the last meeting, made some remarks upon the similarity and probable historical connection between the Chinese syllabic characters, and the Hebrew and other alphabets. The character Sin, on the seal, would be a proper hieroglyph for final n, and it is often written in a form corresponding to an old Punic n. This coincidence in two out of four casual characters, is curious. Out of the twenty-two letters of the Hebrew alphabet, Mr. Chase considers that at least fifteen can be selected, which bear meanings identical with meanings attached to similar forms among the Chinese root characters, and every letter of the Roman alphabet has

one or more strongly marked analogues in Chinese. The resemblances are so numerous and striking, especially between the Chinese cursive and our running hand, that it is difficult to resist the conviction that the parallel forms have a common origin.

The traditions of mythology, if rightly interpreted, would perhaps aid us in tracing alphabetic writing to its source. Although Cecrops, the reputed founder of Athens, is said to have led a colony from Egypt, he has never been credited with the introduction of any portion of the Egyptian learning. But we are told that Cadmus, the Phenician, brought letters into Greece, and that on his entrance into Bœotia, he slew the dragon that guarded the fountain of Mars. By the direction of the Goddess of Wisdom, he sowed the dragon's teeth, and armed men immediately sprang up, of whom all but five perished in a mutual contest. With the assistance of the remainder, he built the city of Cadmea, or Thebes.

Morrison, in his English-Chinese Dictionary, under "Dragon," speaks of the draco, which was the standard of the Roman cohort, and the draconarii, who were the standard-bearers, but he makes no attempt to connect the Cadmean legend with the Chinese. The Lung, or dragon, "the watcher,"* has been the Chinese imperial emblem from time immemorial. It is not only borne on all the royal standards, but it is embroidered or impressed on the clothing, the furniture, and all other articles belonging to the emperor. If we suppose that on the arrival of Cadmus in Bœotia, he routed the Chinese viceroy of the country,—that he fomented a civil war among the Chinese colonists (or dragon's teeth),—that the war raged until the survivors were glad to submit to the rule of the Phenician adventurer, and that he was wise enough to use all the elements of education and civilization in which the former colonists surpassed his own, —the myth becomes intelligible, and points to the probable origin of Greek culture, in one of the early outpourings of that Asiatic hive, that has repeatedly sent its swarms over the plains of Europe, as pioneers in the westward march of empire.

The horse, which Neptune is said to have presented to the Greeks, and the fountain of Mars, may also have a possible pointing towards

* The verbs dr̥ç, and loc, in Sanscrit. both denote watchfulness. The former is akin to the Greek δέρκω, δράκων, and the latter may have a common origin with the Chinese *lung*. Compare Ch. *mang*, Latin *magn-*, Gr. μακ-; Ch. *ping*, Gr. πηγν-, L. *pac*.

Eastern Asia as the source of civilization. The root *ma* in Chinese, signifies "a horse; enraged; martial-like," and it might easily be presumed that the name of Mars was derived from the same root. This coincidence of etymological forms, taken in connection with the well-known fact, that the Phenicians had a perfect alphabet at a time when the use of hieroglyphics in Egypt was nearly or quite universal, may prove to be of some importance.

Prof. Booth, Mr. Foulke, Prof. Coppée, the Rev. Mr. Barnes, Dr. Coates, Prof. Lesley, and Dr. Bache continued the discussion of the subject.

Prof. Booth invited the attention of the members present to the analysis of Delaware and Schuylkill water, by Profs. Booth and Garrett, on page 75 of the lately published Report of the Chief Engineer of the Philadelphia Water Works for 1862.

Pending nominations Nos. 481 to 483, and new nominations Nos. 484 to 490, were read.

The resolutions postponed from the last meeting were laid on the table.

And the Society was adjourned.

Stated Meeting, March 6, 1863.

Present, eighteen members.

Dr. Wood, President, in the Chair.

Letters accepting membership were received from M. J. Boucher de Perthes, President of the Imperial Society of Emulation, at Abbeville, in France, dated February 9th; from M. Fréderic Troyon, of Lausanne, in Switzerland, dated February 10th, and from Dr. A. A. Henderson, U. S. N., dated United States Steam Sloop Richmond, New Orleans, February 20th, 1863.

Donations for the Library were received from Prof. Secchi, the Royal Astronomical and American Oriental Societies,

the Academy of Natural Sciences at Philadelphia, Messrs. Blanchard & Lea, Dr. I. I. Hayes, and Sidney George Fisher, of Philadelphia, Dr. Lewis H. Steiner, of Baltimore, Mr. Gowan, bookseller, of New York, Bishop Duggan, of Chicago, and the Librarian of the University of Michigan.

A copy of the Transactions, Vol. XII, Part iii, was laid on the table.

Prof. Coppée read the following obituary notice of General O. McK. Mitchel.

BIOGRAPHICAL NOTICE.

The subject of this sketch had achieved such brilliant success in science and in arms, that the detailed story of his life would be read with eager interest by his admiring countrymen. It is to be hoped that such a biography will not be withheld; not alone in eulogy of his virtues and his achievements, but as a bright example to ourselves and to our children. It is not, however, the purpose of the writer, here and now, to present these details. It is only intended to glance at the principal objective points in his eager, ardent, devout, and energetic life.

Ormsby McKnight Mitchel was born in Union County, Kentucky, on the 28th of August, 1810. He had the misfortune to lose his father when he was three years old, and thus, from his early infancy, he was left to battle with the world, and win such a place in its esteem, as the God-given genius and indomitable energy he possessed might secure for him. Immediately after his father's death, his family removed to Ohio; and at twelve years of age, he became a clerk in a store in the town of Miami, whence, however, not long after, he moved with his family to Lebanon. A bright and inquiring boy, he soon found the plodding and menial duties of a country store tame, painful, and unsatisfactory.

Always eager in the pursuit of learning, and especially of that practical knowledge which could clear the wilderness, and build towns like magic in our then wild as well as far West, he bent his energies towards procuring an appointment to the Military Academy at West Point, where, he had been told, such instruction was given at the expense of the Government, and an assured future lay beyond to the honorable graduate. He was successful; he entered the Military Academy on the 23d of June, 1825, when not yet fifteen years old,—

being admitted, by special favor, a year earlier than the law allowed. His standing while a cadet was always high, and his pursuit of knowledge, in all its forms, eager and persevering. Among his classmates were the most distinguished generals at present in our own or the rebel service; among the latter were Lee and Joseph Johnston. His letters to his mother and brother during this period, all represent him as an eager student and ambitious in his aims.

In 1829, he graduated with honor, and was appointed a second lieutenant in the Second Artillery. So favorable was the impression produced by his novitiate, that he was very soon detailed for duty at the Academy, as Assistant Professor of Mathematics. He was afterwards, for a short time, stationed at St. Augustine, in Florida. But the prospects of the army at that period could not satisfy the energy and honorable ambition of such a man as Mitchel. He resigned on the 30th of September, 1832, with no fortune, and no prospect but in persevering labor, to achieve fame, usefulness, and honor.

Just after his graduation, the French Revolution broke out,—those "three days of July" which drove the "legitimate" Bourbons once more from the throne they were unworthy to occupy, and elevated the citizen-king, Louis Philippe, to the seat of power. Many remember the effect produced by this volcanic eruption all over the civilized world. It is worthy of record, as illustrative of his character, that our young soldier was not exempt from the pervading influence. His letters to his brother express an unsettled condition of mind, and a growing desire to go to Europe and plunge, sword in hand, into the great wars which he believed would grow out of this change of dynasty. This is mentioned as betokening his quickly kindled enthusiasm, his desire to exercise his newly-acquired powers, and his ardent but honorable ambition for distinction. The spirit of revolution which France evoked, and which stalked for a brief space through Europe, was soon laid, and Mitchel settled, as has been told, into the quiet but hard-working life of a citizen.

While in the army, he had married Mrs. Trask, the widow of Lieutenant Trask, and formerly Miss Louisa Clark, of Cornwall, on the Hudson. In his growing family he found new incentives to labor, and so we see him, in 1832, opening an office as counsellor-at-law in Cincinnati. In this position he remained until the establishment of the Cincinnati College, in 1834, when he was elected Professor of Mathematics, Philosophy, and Astronomy. This post he held until the sad and untimely destruction of the College buildings by fire, and the consequent dissolution of the College. But what

seemed his misfortune was in reality a great blessing. In the routine of academic duties he might have remained satisfied; but when once more thrown upon his own remarkable energies, his "sleepless soul" undertook grand and original adventures.

During the period of his professorship, he could still find time to devote to other public duties. From 1836 to 1837, he was Chief Engineer of the Little Miami Railroad. He had, while in the army, acquired some experience in railway engineering, which was to prove of value on many occasions during his life of peace, and to find brilliant opportunities during his brief but splendid military career. But his principal study was astronomy, the objective science which kindled his ardor and claimed all his devotion. Amid the drudgery of the lawyer's office; while teaching the elements of mathematics and mechanics; in the practical, busy life of a railway engineer, the stars shone upon him with that potent *influence* with which, in earlier days, they had been supposed to shine upon every man. For him, we may almost believe, there was a horoscope, and that all the planets were conjoined in its composition.

In 1842, he undertook to establish the Cincinnati Observatory, now Mitchel's Observatory, a gigantic labor, which would have been too much for talent, energy, and industry less than his own. Of the difficulties which he encountered, we may best judge by his own narrative. Writing in 1848, he says: "My attention had been for many years directed to this subject (the erection of a great astronomical observatory in the city of Cincinnati), by the duties of the professorship, which I then held in the College. In attempting to communicate the great truths of astronomy, there were no instruments at hand to confirm and fix the wonderful facts recorded in the books. Up to that period, our country, and the West particularly, had given but little attention to practical astronomy. A few individuals, with a zeal and ardor deserving of all praise, had struggled on to eminence almost without means or instruments. An isolated telescope was found here and there scattered through the country; but no regularly organized observatory, with powerful instruments, existed within the limits of the United States, so far as I know. . . .

"To ascertain whether any interest could be excited in the public mind in favor of astronomy, in the spring of 1842, a series of lectures was delivered in the hall of the Cincinnati College. To give an increased effect to these discourses (which were unwritten, and in a style of great simplicity), a mechanical contrivance was prepared, by the aid of which the beautiful telescopic views in the heavens were

presented to the audience, with a brilliancy and power scarcely inferior to that displayed by the most powerful telescopes. To this fortunate invention were these lectures ('The Planetary and Stellar Worlds'), no doubt, principally indebted for the interest which they produced, and which occasioned them to be attended by a very large number of the intelligent persons in the city. Encouraged by the large audiences, which continued through two months to fill the lecture-room, and still more by the request to repeat the last lecture of the course in one of the great churches of the city, I matured a plan for the building of an observatory, which it was resolved should be presented to the audience at the close of the lecture, in case circumstances should favor. . . .

"Such is the history of the origin of the Cincinnati Astronomical Society. . . .

"Under its auspices, I started for New York, and on the 16th of June, 1842, sailed for Liverpool. Having visited many of the best appointed observatories both in England and on the Continent (in each and every one of which I was received with a degree of kindness and attention, for which I acknowledge the deepest obligations), and having been unsuccessful in finding, either in London or Paris, an object-glass of the size required, I finally determined to visit the city of Munich. The fame of the optical institute of the celebrated Frauenhofer had even reached the banks of the Ohio, and it was hoped that in that great manufactory, an instrument such as the Society desired might be obtained, if not completed, at least in such a state of forwardness as to permit it to be furnished at an early day. In this I was not disappointed. An object-glass of nearly twelve inches diameter, and of superior finish, was found in the cabinet of M. Mertz, the successor of Frauenhofer. This glass had been subjected to a severe trial in the tube of the great refractor of the Munich Observatory, by Dr. Lamont, and had been pronounced of the highest quality.

"To mount this glass would require about two years, at a cost of nearly ten thousand dollars; a sum considerably greater than that appropriated at the time for an equatorial telescope. Having made a conditional arrangement for this and other instruments, I returned to Greenwich, England, where, at the invitation of Professor Airey, the Astronomer Royal, I remained for some time to study. Having accomplished the objects of my journey, I returned home, and rendered a report to a very large meeting of the members of the Association, and other citizens of Cincinnati. . . .

"The principal instrument having been ordered, and the first payment on its cost made, attention was now given to the procuring of a suitable site for the building. Fortunately for the Society, the place of all others most perfectly adapted to their wants, was then the property of Nicholas Longworth, Esq. It is a lofty hill-top, rising some four hundred feet above the level of the city, and commanding a perfect horizon in all directions. On making known to Mr. Longworth the prospects and wants of the Astronomical Society, the writer was directed by him to select *four acres* on the hilltop, out of a tract of some twenty-five acres, and to proceed at once to inclose it, as it would give him great pleasure to present it to the Association. On compliance with the conditions of the title bond, a deed has since been received, placing the Society in full possession of this elegant position. . . . .

"At length the building was reared, and finally covered in, without incurring any debt. But the conditions of the bond, by which the lot of ground was held, required the completion of the Observatory in two years from its date, and these two years would expire in June, 1845. It was seen to be impossible to carry forward the building fast enough to secure its completion by the required time, without incurring some debt. My own private resources were used, in the hope that a short time after the finishing of the Observatory, would be sufficient to furnish the funds to meet all engagements. The work was pushed rapidly forward. In February, 1845, the great telescope safely reached the city of Cincinnati, and in March the building was ready for its reception. I had now exhausted all my private means, and to increase the difficulty of the position in which I was placed, the College edifice took fire, and burned to the ground. My ordinary means of support were thus destroyed at a single blow. I had engaged to conduct the Observatory, without compensation from the Society, for ten years, in the hope that my College salary would be sufficient for my wants. It was impossible to abandon the Observatory. The College could not be rebuilt, at least, for several years, and in this emergency, I found it necessary to seek some means of support, least inconsistent with my duties in the Observatory. My public lectures at home had been comparatively well received, and after much hesitation, it was resolved to make an experiment elsewhere. For five years I had been pleading the cause of science among those little acquainted with its technical language. I had become habituated to the use of such terms as were easily understood; and probably to this circumstance more

than to any other one thing, am I indebted for any success which may have attended my public lectures. To the citizens of Boston, Brooklyn, New York, and New Orleans, for the kindness with which they were pleased to receive my imperfect efforts, I am deeply indebted. My lectures were never written, and no idea was entertained of publishing a course, until the partiality of my friends induced me to attempt this experiment."

Thus it was that, in 1842, he began his remarkable career as a lecturer on astronomy. More than any other man in America has he thus accomplished for his favorite science. Besides the Observatory he founded, and the instruments he imported, and to which he has greatly added by his improvements and inventions, he awakened in thousands of minds an interest in the subject, instructed popular assemblies, not only by his clear outlines of the gigantic science, but by his masterly handling of its difficult and abstruse theories and problems, and by his fiery words, which exhibiting his own knowledge and enthusiasm, told of its divine beauties and relations, and kept crowded audiences all over the country in breathless and delighted attention.

He found time to begin, in 1846, the publication of the Siderial Messenger, a popular astronomical monthly, which was regularly issued for more than a year.

He had surveyed the Ohio and Mississippi Railroad in 1844, and when the enterprise was fairly undertaken, and the road placed under contract, he was sent to Europe by the Company, as a confidential agent on the business of the road, in 1853, and again on the same business in 1854. For some time he was the President of the Cincinnati division of that road, and was chiefly instrumental in bringing it to a successful completion.

In the summer of 1860, he was appointed Director of the Dudley Observatory, and, without a reference to the unhappy difficulties which beset that institution at the beginning, it may be said that his acceptance of the post restored quiet, and produced the greatest usefulness of which the Observatory was instrumentally and financially capable. It was still under his direction at the time of his death.

When the war broke out, Professor Mitchel, urged singly and purely by patriotic motives, placed his services at the disposition of the Government, and devoted his life and military knowledge to his country. On the 9th of August, 1861, he was appointed a Brigadier-General of Volunteers, and was placed in command of the De-

partment of the Ohio, with his headquarters at Cincinnati. While there he carefully surveyed the approaches to the town, and built redoubts and projected defences at the prominent points, which doubtless served a good purpose when, at a later day, Cincinnati was threatened by an overwhelming rebel force.

When the Departments of the Ohio and the Cumberland were afterward united, General Mitchel was ordered to report to General Buell; and he was then placed in command of a camp of rendezvous, where he was actively receiving, organizing, and forwarding troops for three weeks. At the expiration of this brief period, he was appointed to the command of the Third Division of the Army of the Ohio, then stationed at Elizabethtown, Kentucky. If we particularize in dates and positions, it is that the reader may trace the rapid and energetic movements of General Mitchel the more intelligibly.

On the 9th of February, 1862, he was at Bacon Creek; on the 13th he started for Bowling Green, until then the strongest point on the strategic line of the rebel army. Forced marches, in themselves a wonderful feat with new troops, brought him to Bowling Green on the 15th. On the 22d, he started with General Buell for Nashville; and it is worth recording that that city was surrendered to Colonel Kennett, of the Fourth Ohio Calvary, for General Mitchel, on Sunday evening, February 23d. The surrender is publicly believed to have been made to General Nelson, but that officer did not arrive with his division to occupy the place until three days after it had capitulated to General Mitchel. He had now entered upon those brilliant independent movements which had excited the admiration of the whole country, and which, could he have received timely and adequate reinforcements, would have redeemed the entire region in which they were made. Early in March, he was at Murfreesboro', where, putting his railroad experience in practice, he improvised twelve hundred feet of bridges. Leaving Murfreesboro' on the 6th of April, he marched to Shelbyville; on the 10th, he was at Fayetteville; and on the 11th, at Huntsville, in Alabama. Here, again, the railway engineer supplied valuable generalship. Seizing the rolling stock, he immediately sent out two railway expeditions, east and west, the one to Decatur, and the other to Stevenson, on the Memphis and Charleston Railroad. The expedition to Stevenson he conducted in person. Both places were captured, and Northern Alabama was in Federal possession, one hundred and twenty miles of the railroad being in running condition, and guarded by Mitchel's troops.

For this brilliant achievement, he was made a Major-General of Volunteers, to date from April 11th, the day of the capture of Huntsville.

On the 2d of July, General Mitchel was ordered to report himself at Washington. He was there in person on the 5th. From that time he was waiting for orders until September 12th, when he started for the important command of the Tenth Army Corps, the head-quarters of which were at Hilton Head, South Carolina. He reached there on the 16th. His coming infused new life into the department, and he was maturing his plans for a grand movement, when he was called away from earth. He sent an expedition to St. John's River, which captured the fort, with many heavy guns; and also a force to Pocotaligo, for the purpose of destroying the Charleston and Savannah Railroad and telegraph, in which it was successful. He also drew Beauregard out of Savannah with twenty-five thousand men. What he further intended cannot be told, but every day, had he lived, would have disclosed the character of his projects, of which these movements were but the initiation.

While in the midst of his usefulness and rapidly maturing plans, he was attacked by the yellow fever on Sunday, the 26th of October, and died on October 30th, 1862, in Beaufort, South Carolina.

Such, briefly, is the record of his life. The meagre recital is full of valuable lessons, and leads the scholar, the patriot, the soldier, and the Christian to moralize upon the great loss the country has sustained, while they eulogize his genius, his talents, his virtues, his piety, and his lofty achievements. Few men of our age have exhibited a more extended genius, and we know of no one who has displayed so much energy in everything he has undertaken. His character will bear minute analysis; in every department of labor he was successful; in many he was truly eminent.

As a *man of science*, Professor Mitchel was an ardent investigator, and an eminently practical inventor. Fully imbued with the poetry of science, delighting in the lofty picturesques of astronomic thought, abounding in the rarest imagery in his public teachings, his true sphere was in the mechanism of the means for scientific observation and labor. To prepare himself as director of the Observatory, he had studied and mastered the higher astronomical mathematics, and was thoroughly conversant with the history of the science. To qualify himself as a public teacher, he had resolved the most difficult problems into such simple forms and such lucid language, as to make them clear to many who had regarded it impossible to compre-

hend them. To give himself facility in observing, he had studied under Professor Airey, the Astronomer Royal of England at Greenwich; and to understand the scientific relations of astronomy as they appear in the cosmogony of the universe, he had investigated those sister sciences which, while they are elements of the great subject, come forward in their progress of development to cast their tribute at the feet of Him who dictated the record of Moses.

As a mechanical inventor, he may be best presented by placing in this connection, some account of the principal instruments which he created for facilitating observations.

The following description of the Declinometer is furnished through the kindness of Mr. G. W. Hough, the astronomer in charge of the Dudley Observatory:

"Method invented by Professor Mitchel for determining difference of declination.

"The apparatus for observing difference of declination consists of the following:

"To the axis of the transit telescope is attached a metallic arm of sixty inches in length; in the lower end of this arm is screwed a cylindrical pin, one-eighth of an inch in diameter, at right angles to the arm and parallel to the supporting axis of the telescope. This pin has a notch or groove (of the form which would be generated by placing the vertices of two isosceles triangles together, and revolving about the perpendicular), cut in the middle.

"At a distance of twenty-three inches from the pin, and in the same horizontal plane, is mounted in Y's a small telescope of six inches focal length. The supporting axis of this telescope is parallel to that of the transit. Underneath the centre of the small telescope, and connected with it, is a short arm two inches in length, and by means of a joint, a rod is connected with the pin before mentioned.

"Now when the transit telescope is moved in zenith-distance, angular motion is given to the small telescope, by means of the long arm and connecting-rod.

"The amount of this motion is read from a scale, placed at a distance of fifteen feet, and divided to single seconds of arc. It will, of course, be understood that we must have some object in the focus of the small telescope with which to compare the divisions of the scale. We use either a cross formed by the intersection of two spider's webs, or a single horizontal wire.

"In case we wish to observe a zone of greater width than the extent of the scale (30′), we have a number of pins, at distances of

30′ apart, mounted in the arc of a circle whose radius is equal to the length of the long arm. We readily pass from one pin to another, by lifting one end of the connecting-rod, and attaching it to a different one. The divisions on the scale can easily be read by estimation, to two-tenths of a second of arc.

"The time required to read the scale is much less than that employed in reading *one* microscope, since at the same transit of an equatorial star we can make from ten to fifteen bisections and readings. As I have found one reading of the scale nearly equal to four microscopes, it follows that if we employ the same time in the observation of an object with the Declinometer that we do when we use the Circle, our results in the former case will be superior to the latter in a large ratio.

"The Zone observations with the Declinometer have been made mostly for the investigation of the source and amount of error due to this method. From a comparison of the observations with those made in the ordinary way, I find the probable error, on a single observation, falls within the limits of accuracy usually assigned to observations made with the Meridian Circle. One great advantage lies in the fact that many bisections and readings can be made at the same transit, and in this way eliminating the ordinary errors of observation. You will understand the rapidity with which work can be done by this method, when I state that more than two hundred stars have been accurately observed in one hour; and were they equally distributed, twice that number could easily have been taken.

"This instrument is one of the great inventions of our late and lamented director, Professor Mitchel, and is the only one in the world.

"From observations made during the last two years, and a careful discussion of the results, I have arrived at the conviction *that there is no other known method equal to it, for rapidity and accuracy, in the cataloguing of stars.*"

Professor Mitchel's remarkable mechanical skill, his quickness to perceive difficulties, and the readiness with which he devised and applied the remedies, are further admirably illustrated in his apparatus for recording time by means of the electro-magnetic telegraphs. These are now in use in the Cincinnati and Dudley Observatories. His was the first thorough solution of this important problem in instrumental astronomy. The following account of this apparatus is in Professor Mitchel's own words:

"The problem of causing a clock to record its beats telegraphically, was nothing more than to contrive some method whereby the clock might be made (by the use of some portion of its own machinery) to take the place of the finger of the living, intelligent operator, and 'make' or 'break' the electric circuit. The grand difficulty did not lie in causing the clock to play the part of an automaton in this precise particular, but it did lie in causing the clock to act automatically, and at the same time perform perfectly its great function of a timekeeper. This became a matter of great difficulty and delicacy; for to tax any portion of the clock machinery with a duty beyond the ordinary and contemplated demands of the maker, seemed at once to involve the machine in imperfect and irregular action. After due reflection it was decided to apply to the *pendulum* for a minute amount of power, whereby the making or breaking the electric circuit might be accomplished with the greatest chance of escaping any injurious effects on the going of the clock. The principle which guided in this selection was, that we ought to go to the prime mover (which in this case was the clock weights, and which could not be employed), and failing to reach the prime mover, we should select the nearest piece of mechanism to it, which in the clock is the pendulum. A second point early determined by experiment and reflection was this: that the making or breaking of the circuit must be accomplished by the use of mercury, and not by a solid metallic connection. Various methods were tried, and soon abandoned as uncertain and irregular in their results, and the following plan was adopted:

"A small cross of delicate wire was mounted on a short axis of the same material, passing through the point of union of the four arms constituting the cross. This axis was then placed horizontal on a metallic support in Y's, where it might vibrate, provided the top stem of the cross could be in some way attached to the pendulum of the clock, and the 'cross' should thus rise and fall at its outer stem as the pendulum swings backward and forward. The metallic frame bearing the 'cross' also bore a small glass tube bent at right angles. This was filled with mercury, and into one extremity one wire from the pole of the battery was made to dip; the other wire was made fast by a binding screw to the metallic stand bearing the 'cross,' and thus every time the 'cross' dipped into the mercury in the bent tube, the electricity passed through the metallic frame, up the vertical standards bearing the axis of the cross, along the axis to the stem, and down the stem into the mercury, and finally through

the mercury to the other pole of the battery. Thus at every swing of the pendulum the circuit was made, and a suitable apparatus might, by the electro-magnet, record each alternate second of time.

"The amount of power required of the pendulum to give motion to the delicate wire-cross was almost insensible, as the stems nearly counterpoised each other in every position. Here, however, there was great difficulty in procuring a fibre sufficiently minute and elastic to constitute the physical union between the top stem of the cross and the clock pendulum. Various materials were tried, among others a delicate human hair, the very finest that could be obtained, but this was too coarse and stiff. Its want of pliancy and elasticity gave to the minute 'wire-cross' an irregular motion, and caused it to rebound from the globule of mercury into which it should have plunged. After many fruitless efforts, an appeal was made to an artisan of wonderful dexterity; the assistance of the *spider* was invoked. His web, perfectly elastic and perfectly pliable, was furnished, and this material connection between the wire-cross and the clock pendulum proved to be exactly the thing required. In proof of this remark, I need only state the fact that one single spider's web has fulfilled the delicate duty of moving the wire-cross, lifting it, and again permitting it to dip into the mercury every second of time for a period of more than three years! How much longer it might have faithfully performed the same service I know not, as it then became necessary to break this admirable bond, to make some changes in the clock. Here it will be seen the same web was expanded and contracted each second during this whole period, and yet never, so far as could be observed, lost any portion of its elasticity. The clock was thus made to close the electric circuit in the most perfect manner; and inasmuch as the resistance opposed to the pendulum by the 'wire-cross' was a constant quantity and very minute, thus acting precisely as does the resistance of the atmosphere, the clock, once regulated with the 'cross' as a portion of its machinery, moved with its wonted steadiness and uniformity. Thus one grand point was gained. The clock was now ready to record its own beats automatically and with absolute certainty, without in any way affecting the regularity of its movement. It was early objected to the mercurial connection just described, that in a short time the surface of the mercury would become oxydized, and thus refuse to transmit the current of electricity; but experiment demonstrated that the explosion produced by the electric discharge at every dip into the mercury threw off the oxyd formed, and left the polished

surface of the globule of mercury in a perfect state to receive the next passage of the electricity.

"So far as known, all other methods are now abandoned, and the mercurial connection is the only one in use.

"THE TIME-SCALE.—The clock being now prepared to record its beats accurately and uniformly, the next important step was to obtain, if possible, a uniformly moving time-scale, which should be applicable to the practical demands of the astronomer.

"In case the fillet of paper used in the Morse telegraph could have been made to flow at a uniform rate upon its surface, the clock could now record, its beats appearing as dots separated from each other by equal intervals. But it was soon seen that the paper could not be made to flow uniformly; and even had this been possible, a single night's work would demand for its record such a vast amount of paper, that this method was inapplicable to practice. After careful deliberation, the 'revolving disk' was selected as the best possible surface on which the record of time and observation could be made. The preference was given to the disk over the cylinder for the following reasons: The uniform revolution of the disk could be more readily reached. The record on the disk was always under the eye in every part of it at the same time, while on the revolving cylinder, a portion of the work was always invisible. One disk could be substituted for another with greater ease, and in a shorter time, and the measure of the fractions of seconds could be more rapidly and accurately performed on the disk than on the cylinder.

"After much thought and experiment, it was decided to adopt 'a make circuit' and 'a dotted scale' rather than a 'break circuit' and a 'linear scale;' and I think it will be seen hereafter that in this selection, the choice has been fully justified in practice. These points being settled, the mechanical problems now presented for solution were the following: First, To invent some machinery which could give to a disk of, say twenty inches diameter, mounted on a vertical axis, a motion such that it should revolve uniformly once in each minute of time; and second, to connect with this disk, the machinery which should enable the clock to record on the disk each alternate second of time, in the shape of a delicate round dot. Third, The apparatus which should enable the observer to record on the same disk the exact moment of the transit of a star across the meridian, or the occurrence of any other phenomenon.

"The first of these problems was by far the most difficult, and indeed, its perfect solution remains yet to be accomplished, though

for any practical astronomical purpose, the problem has been solved in more than one way.

"The plan adopted in the Cincinnati Observatory may be described as follows: The clock-work machinery employed to give to the great equatorial telescope a uniform motion equal to that of the earth's rotation on its axis, offered to me the first obvious approximate solution of the problem under consideration. This machinery was accordingly applied to the motion of the disk, or rather to *regulate* the motion of revolution, this motion being produced by a descending weight, after the fashion of an ordinary clock. It was soon discovered that the 'Frauenhofer clock,' as this machine is called, was not competent to produce a motion of such uniformity as was now required. Several modifications were made with a positive gain; but after long study it was finally discovered that when the machinery was brought into perfect adjustment, the dynamical equilibrium obtained was an equilibrium of instability; that is, if from a motion such as produced a revolution in one exact minute, it began to lose, this loss or decrement in velocity went on increasing, or if it commenced to gain, the increment went on increasing at each revolution of the disk. Now all these delicate changes could be watched with the most perfect certainty; as in case the disk revolved uniformly once a minute, then the seconds' dots would fall in such a manner (as we shall see directly), that the dots of the same recorded seconds would radiate from the centre of the disk in a straight line. Any deviation from this line would be marked with the utmost delicacy down to the thousandth of a second. By long and careful study, it was at length discovered, that to make any change in the velocity of the disk, to increase or decrease quickly its motion, in short, to restore the dynamical equilibrium, the winding key of the 'Frauenhofer clock' was the point of the machinery where the extra helping force should be applied; and it was found that a person of ordinary intelligence stationed at the disk, and with his fingers on this key, could, whenever he noticed a slight deviation from uniformity, at once, by slight assistance, restore the equilibrium, when the machine would perhaps continue its performance perfectly for several minutes, when again some slight acceleration or retardation might be required from the sentinel posted as an auxiliary.

"The mechanical problem now demanding solution was very clearly announced. It was this: Required to construct an automaton which should take the place of the intelligent sentinel, watch the going of the disk, and instantly correct any acceleration or retarda-

tion. This, in fact, is the great problem in all efforts to secure uniform motion of rotation. This problem was resolved theoretically in many ways, several of which methods were executed mechanically without success, as it was found that the machine stationed as a sentinel to regulate the going of the disk was too weak, and was itself carried off by its too powerful antagonist. The following method was, however, in the end, entirely successful. Upon the axis of the winding key already mentioned, a toothed wheel was attached, the gearing being so adjusted that one revolution of this wheel should produce a whole number of revolutions of the disk. The circumference of this wheel was cut into a certain number of notches, so that as it revolved, one of these notches would reach the highest point once in two seconds of time. By means of an electro-magnet, a small cylinder or roller, at the extremity of a lever arm, was made to fall into the highest notch of the toothed wheel at the end of every two seconds. In case the disk was revolving exactly once a minute, the roller, driven by the sidereal clock, by means of an electro-magnet, fell to the bottom of the notch, and performed no service whatever; but in case the disk began to slacken its velocity, then the roller fell on the retreating inclined face of the notch, and thus urged forward by a minute amount the laggard disk, while on the contrary, should the variation from a uniform velocity present itself in an acceleration, then the roller struck on the advancing face of the notch, and thus tended slowly to restore ths equilibrium. Let it be remembered that this delicate regulator has but a minute amount of service to perform. It is ever on guard, and detecting, as it does instantly, any disposition to change, at once applies its restoring power, and thus preserves an exceedingly near approach to exact uniformity of revolution. This regulator operates through all the wheel-work, and thus accomplishes a restoration by minute increments or decrements spread over many minutes of time.

"With a uniformly revolving disk, stationary in position, we should accomplish exactly and very perfectly. the record of one minute of time, presenting on the recording surface thirty dots at equal angular intervals on the circumference of a circle. To receive the *time dots* of the next minute on a circle of larger diameter, required either that the recording pen should change position, or that at the end of each revolution, the disk itself should move away from the pen by a small amount. We chose to remove the disk. To accomplish accurately the change of position of the disk, at the end of each revolution, the entire machine was mounted on wheels on a small railway track, and

by a very delicate mechanical arrangement, accomplished its own change of position between the fifty-ninth and sixtieth second of every minute."

But Professor Mitchel was also a very successful observer. He remeasured Struve's double stars south of the equator, discovered the companion of Antares, and added many new stars to the catalogue.

As a *lecturer*, Professor Mitchel had a remarkable gift. His fervid oratory was natural. It was the truest exemplification of the trite but striking idea of the poet,

"Thoughts that breathe, and words that burn."

He could make a dry problem in mathematical astronomy so pleasing, by its clear and eloquent presentation, as to enchain a popular assembly, and extort their applause both for problem and lecturer. His language, purely extemporaneous, was beautiful; his figures and illustrations strikingly well chosen, and his voice and manner powerful and overmastering. Sometimes his fervor seemed like a Delphian inspiration, and there are few among those who heard him who can forget the magnificent effects produced by his lectures on astronomy in this and other cities.

As a true and whole-hearted *patriot* he had no superior. Influenced by this spirit, he tore himself from home ties, alas! not capable of bearing the rude parting, for his departure cost him his cherished wife,—and thus he gave himself up to his country. All his energies, all his talents, his varied education, his fame, his brilliant future,—whatever there was of power or influence in him or his name was hers, devoted to her with a single eye and a single purpose. And he died for her as truly, as devotedly,—shall we not say as gloriously,—as though he had fallen leading a forlorn hope to turn disaster into victory?

But as a *soldier*, his whole-hearted patriotism was of great value. Bred at West Point, and having engrafted upon that thorough elementary education the knowledge of men, of life, of practical science and industrial arts, he was the very *beau-ideal* of a general. Full of resources, he made bridges of cotton bales and fence rails, and was the first man across to test their precarious structure. Restlessly energetic, his mind passed like lightning over every part of a plan or a field; his quick glance caught the capabilities of a position; his experience provided whatever was needed; his surplus vitality, over-

flowing his own person, swept out among the soldiers, and put the whole mass in motion. His great personal bravery was a constant example and incentive to every man under his command. Wherever he appeared, there was work to do,—expeditions, rapid movements, concerted combinations, forced marches. Without making too sweeping a remark, we may consider General Mitchel as among the very best of our commanders; and had he lived, he would have risen to a position in public esteem and confidence second to none in the land.

As a devout Christian,—not presented now to the world in the mere statement of a charitable opinion, which gives "a good conscience" to every public man who dies,—but as a consistent, conscientious, devout Christian man, General Mitchel is best known to his home and his intimate friends. Admiring, as they do, his brilliant qualities, his learning, his genius, his military fame, they recur with far more comfort to the fact of his holy and fervent life, his daily communion with his God, his practical piety, his certain and holy hope of eternal life through the blood of Christ.

No king stood by his dying bed beseeching him,

> "If thou think'st on Heaven's bliss,
> Hold up thy hand, make signal of thy hope."

Prompted by the unutterable thoughts which crowded upon him, he gave unbidden such a happy signal, literally holding up his hand, and pointing to that world beyond the skies, which was then lifting "its everlasting portals high" to greet him with an immortal radiance, such as even his enthusiastic astronomy had never conceived. His last words, brokenly uttered, were taken down by his aide-de-camp, and add another to the ever-increasing and enduring testimonies, that when the good man dies, God alone is great, and Heaven alone is real existence.

General Mitchel had filled many offices and posts, and was, as might be expected, the recipient of many honors due to his own merits. A graduate of West Point, he was a lieutenant of artillery, a lawyer, a railway engineer, an astronomer, the founder of one observatory, the director of two; a Doctor of Laws from more than one institution; a Fellow of the Royal Astronomical Society, and of several other foreign societies; a Major-General of Volunteers.

In 1841, he was appointed by the President a member of the Board of Visitors to the Military Academy. In 1847 and 1848, he

was Adjutant-General of Ohio. In 1848, he published a work called "The Planetary and Stellar Worlds," containing a popular exposition of the important discoveries of modern astronomy. In 1860, his "Popular Astronomy" appeared, a concise elementary treatise on our sun, planets, satellites, and comets; and there is now passing through the press, to be published at an early day, a volume called "The Astronomy of the Bible," in which he endeavors to show that science and revelation may be made eventually to harmonize perfectly.

He was elected a member of the American Philosophical Society in 1853.

Pending nominations Nos. 481 to 490, and new nomination No. 491 were read.

And the Society was adjourned.

Stated Meeting, March 20, 1863.

Present, seventeen members.

Dr. Wood, President, in the Chair.

A letter accepting membership was received from Josiah D. Whitney, lately elected, dated San Francisco, February 13, 1863.

Letters acknowledging the receipt of copies of the Transactions and Proceedings were received from the London Society of Antiquaries, February 27th; the Newcastle Natural History Society, February 24th; the National Museum of Scotland, January 24th; the Massachusetts Historical Society, February 19th and March 16th; the Austrian Consulate at New York, March 19th; the Pennsylvania Historical Society, March 13th; Dr. Charles M. Wetherill of the Agri-

cultural Department, Washington, March 16th, and the St. Louis Academy, March 17th, 1863.

Donations for the Library were received from Mr. Edward Miller, the Bureau of Mines at Paris, the London Meteorological Society, Royal Geographical Society, and Society of Arts, the Scottish Antiquarian Society, the Laval University at Quebec, Mr. Henry Hall, of Rutland, Vermont, the New Bedford Free Public Library, Silliman's Journal, the Franklin Institute, the Pennsylvania Historical Society, and the Cincinnati Young Men's Mercantile Library Association.

Professor Lesley read the following communication from President J. W. Dawson, of McGill College, Montreal.

Note on Mr. Lesley's Paper on the Coal-measures of Cape Breton.

The new facts and general considerations on the Nova Scotia coal-field contained in this paper, are of the highest interest to all who have worked at the geology of Nova Scotia. I think it my duty, however, to take exception to some of the statements, which I think a larger collection of facts, would have induced Mr. Lesley himself to modify. My objections may be stated under the following heads.

(1.) It is scarcely safe to institute minute comparisons between the enormously developed coal-measures of Nova Scotia, and the thinner contemporary deposits of the West, any more than it would be to compare the great marine limestones of the period at the West, with the slender representatives of the part of the group to the eastward.

(2.) There is the best evidence that the coal-measures of Nova Scotia never mantled over the Devonian and Silurian hills of the Province, but were on the contrary, deposited in more or less separate areas on their sides.

(3.) Any one who has carefully compared the coal-measures of the Joggins with those of Wallace and Pictou, must be convinced of the hopelessness of comparing individual beds, even at this comparatively small distance. *A fortiori* detailed comparisons with Pennsylvania and more distant localities must fail.

(4.) I do not think that any previous observer has supposed that the coal-measures of Eastern Cape Breton represent the whole of the

coal formation of Nova Scotia. The "Upper coal-measures" of my papers on Nova Scotia are certainly wanting, and probably the Sydney coal-field exhibits no beds higher than the middle of No. 4 of Logan's Joggin section.

(5.) The whole of the coal-beds in the Joggin section belong to the *Upper* and *Middle* coal-measures. It is quite incorrect to identify No. 6 of Logan's section with the *Lower* coal-measures. These do not occur at the Joggins, but are found in Nova Scotia, as in Virginia and Southern Pennsylvania, at the base of the system, under the marine limestones. The Albert beds are the equivalents of these Lower measures, and not of the Pictou coal. In my paper on the Lower Carboniferous coal-measures (Journal of Geological Society of London, 1858), will be found a summary of the structure of the Lower coal-measures, as shown at Horton Bluff, and elsewhere. The term "true coal-measures," quoted by Mr. Lesley, does not mean in my description, the Middle coal-measures, but merely that part of them holding the workable coal-seams.

(6.) Whatever may be the value of M. Lesquereux's applications of the fossil flora to the identification of coal-seams in the West, I am prepared to state, as the result of an extensive series of observations, still for the most part unpublished, that in Nova Scotia, the flora is identical throughout the whole enormous thickness of the Middle coal-measures, and that the differences observable between different seams, are attributable rather to difference of station and conditions of preservation, than to lapse of time. It is, indeed, true, as I have elsewhere explained, that the assemblages of species in the Lower, Middle, and Upper coal-measures, may be distinguished; but within these groups the differences are purely local, and afford no means for the identification of beds in distant places.

(7.) I do not desire to offer any opinion on the questions raised by some American geologists, as to the extension of the term carboniferous to the Chemung group; but I know as certain facts, that the flora of the Lower coal-measures, under the marine limestones and gypsums of Nova Scotia, is wholly carboniferous, and that the *flora*, on which alone I consider myself competent to decide, of the Chemung of New York, as now understood by Professor Hall, and others, and also of the groups in Pennsylvania, named by Rogers, Vergent, and Ponent (? IX and X of Mr. Lesley), is as decidedly Devonian, and quite distinct from that of the carboniferous period.*

* See Paper on Devonian Flora of Eastern America, Jour. Lond. Geol. Soc. November, 1862.

For Mr. Lesley's ability as a stratigraphical geologist, I have the highest respect; and with reference to the present subject, would merely desire to point out that he may not have possessed a sufficient number of facts to warrant some of his generalizations, on which in the meantime I would, for the reasons above stated, desire geologists to suspend their judgment.

J. .W DAWSON.

McGILL COLLEGE, MONTREAL,
February 18th, 1863.

Mr. Lesley remarked that he read this communication of his friend, Professor Dawson, with great pleasure, as it would prevent any mistake about the nature and importance of the discussion, and any undue weight being attached to his own suggestions; that no one was more convinced than himself that there could be no excuse for dogmatism where so little was known, and therefore, that he had intended rather to suggest than to defend those opinions expressed in his paper, which had drawn down so earnest and valuable a caveat from so high a source. To defend them would require long and systematic researches on the ground, if even then, the too easily accepted present standpoint of palæontology would not hide the truth from view behind immovable obstacles. So long as apparent specific identity in organic forms continues to be accepted as the supreme test of stratigraphical horizon, discord is inevitable. When palæontology is prepared to return under the mild dominion of her mother, lithology, which she has at least one-half repudiated, geology will advance more rapidly in her work.

Professor Dawson's first objection is a begging of the very question, Whether the coal-measures of Nova Scotia *are* "enormously developed." That, in one little spot of the earth's surface like Nova Scotia, and that too midway between the great coal areas of America and those of Europe, wherein the thickness of coal-measures proper range from 2000 to 5000 feet, if they even attain the latter size, there should be an anomalous deposit of 25,000 feet, is incredible. What the great Bohemian palæontologist, by unerring instinct, said to us after our thirty years' war over the Taconic system, *there must be a mistake somewhere,* I must repeat to those who so "enormously develop" the Nova Scotia coal-measures. And my inten-

tion in the paper on Nova Scotia coal was only to suggest one formula on which the error might be discussed. I distinctly repudiated the safety of instituting "minute comparisons." My comparison of the Cape Breton coals and the column at Pittsburg, was carefully made in the most general manner, and the resemblance called a coincidence. But the value of the comparison remains; for it affords a new argument in favor of the *family likeness* of those parts of the general coal-measures of different countries, which have a right to the specific title of "productive coals." The argument also remains good, that if 2000 feet of coal-measures in Missouri can be recognized in 2000 feet of coal-measures in Kentucky, Virginia, and Eastern Pennsylvania, the very same system of beds, bed for bed, being demonstrated first by stratigraphy, and then by palæontology (and such is the fact), why not in Nova Scotia? Even granting (3) that sufficient skill and care and opportunity combined have hitherto failed to identify the coals of the Joggins with those of Wallace and Pictou, there is still hope at the bottom of the box. Before Lesquereux perched himself like a Simon Stylites on the slack heap at the mine's mouth, our own identification of individual beds was very imperfect, and the search for a complete system of identification had been abandoned with the same sense of hopelessness. But how is it now? There certainly may be special difficulties in Nova Scotia; there are such at Pottsville; in Michigan; but they are exceptions which prove the rule, instead of affording an *a fortiori* argument against it.

I have no doubt that some of the coal-measures of the British Provinces may have been "deposited in more or less separated areas on the sides of the Devonian and Silurian hills," as Professor Dawson says (2). But I confess to a complete scepticism of the great extent which has been assigned to this nonconformability of the coal-measures upon the Lower Rocks; first, because most of the Island of Cape Breton, and much of the surface of Nova Scotia and New Brunswick are confessedly unstudied and almost unknown; secondly, because the incredible thickness assigned to the coal-measures, throws doubt upon the positions assigned to the nonconformable horizons; thirdly, because the coal-beds themselves stand almost vertical in many places round the shores; fourthly, because the mountains of Nova Scotia, with apparently conformable carboniferous limestones, have apparently an Appalachian structure and aspect, have suffered vast denudation, exhibit cliff outcrops and section ravines, and may just as well have carried coal upon their original backs, as we can prove that our Tussey, Black Log, Nescopec, Mahoning, Buffalo, Tuscarora,

Brush, and other Silurian and Devonian mountains did. There is an immense nonconformable chasm in the column west of the Hudson River, and the Catskill Mountains over it have no coal upon their backs; but the coal comes in regularly enough on them at the Lehigh, (a less distance than from Sydney to St. Peters, or from Pictou to Windsor), and the nonconformability in the Upper Silurian and Devonian has already disappeared.

Professor Dawson's fourth objection would be good, if I had really "supposed the coal-measures of Eastern Cape Breton to represent the whole of the coal-measures of Nova Scotia." But I only suggested that they may prove to be the equivalents of the system of *productive coal-measures;* that is all. Between the Monongahela and the Ohio, our column of productive coals is capped by another of barren shales and soft sandstones of unknown height, by one estimate 3000 feet thick; and part of this column may represent the so-called Permian measures, which, in Kansas, cap conformably the coal-measures. Having no knowledge of the fossils, I have no desire to oppose the conclusions of Professor Dawson, as to the part of the column of the Joggins to which the Glace Bay coals apply, but hope that his accurate handling of them will secure some certainty about it. It was the grouping of the beds, and not the fossils, which I wished to bring into prominent notice; because the doctrine of isolated basins, when unfounded or overapplied, is as injurious to lithological truth, as the careless identification of surface aspect may at any moment prove to palæontology. I willingly leave to accomplished palæontologists like Professor Dawson, the discussion of the grand generalization embodied in his sixth objection; but I may be permitted to believe that it has had its birth in the doctrine of isolated basins, and that the two must stand or fall together. It also seems to me to involve radical inconsistencies; for if I comprehend it, it asserts, 1. That the flora of the whole coal-measures (25,000 feet?) is identical; that is, the vertical distribution of each and all the plants is complete from the bottom to the top. 2. That nevertheless, there are differences observable between different coal-beds. 3. That these are attributable rather to difference of station and conditions of preservation, than to lapse of time; that is, if we could take the beds, each one in its whole extent and its fossils in their original condition, there would be no differences observable between different seams after all. 4. That groups or assemblages of species in the Lower, Middle, and Upper coal-measures may nevertheless be distinguished; that is, while each and every species may be found occasionally in all parts of the

column from bottom to top, yet this happens in such a manner as to group some of them more abundantly, or in certain peculiar proportions in the Lower, others in the Middle, and others in the Upper portions of it. 5. That, after all, however, these groups are not persistent, but differ at different localities, and are as worthless as the specific forms themselves for the identification of a single bed in more than one place.—Is it possible that all this has been made out, or *can* be made out, except in a country of *horizontal* coal-measures, well opened for study, where the stratification can be established beforehand, and the range of the fossils be doubtless?

In conclusion I would say, that the want of clearly defined and applied names is a drawback to such a discussion. The discussion is in fact *initially* one of names, viz., how far down the name Carboniferous must be carried; what are the Lower coal-measures, &c. But *in the end*, it is a question of vital importance to the value of the palæontological *imprimatur* upon stratigraphical and structural deductions from field work. Is the discovery of specific forms to keep all our geological *niveaux* in a perpetual mirage-flicker? Are we never to know from day to day, whether we are at work in Devonian or Carboniferous, in Trias, (Dyas,) or Lias? Why not at once obey the marriage law of the weaker sex, and give up our names for our lord's? Let geology forget the virgin nomenclature of her youth, and rewrite her books with such titles for her chapters as these: "The Spirifeferous Formation; The Lepidodendriferous Formation; The Lower Thecodont; The Middle Baculite; The Upper Pterodactylian Formations." Why has this not already been done? Simply because it cannot be done. No palæontologist has yet been bold enough even to propose it. Yet as I believe, the 25,000 feet of coal-measures in the British Provinces, will be found to be one of the many unconscious *realizations* of this idea, when no one can be found to *nominate* it openly. The whole palæozoic system at its thickest place in Southeast Pennsylvania and Middle Virginia, is but 35,000 feet. It is not unreasonable then to *suggest*, if not to affirm, that the vast column of so-called coal-measures in Nova Scotia will take in all that part of the palæozoic column which has furnished coal, and that is from the top downwards nearly to the Upper Silurian, as Plate II will show.

A letter was received from Dr. C. M. Wetherill, containing some notice of his observations on the deterioration of ether from age, and its absorption of fusil oil in the special instance described.

DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C., March 16th, 1863.

TO SEC. AM. PHIL. SOC., PHILADA.

DEAR SIR: I have lately made an observation in my laboratory, which I desire to have recorded, as throwing light upon the deterioration of ether by age. I have communicated it to Dr. W. G. T. Morton, who deems it very interesting in its relation to anæsthesia. The subject is worthy of a further examination, which my official duties at present forbid.

I brought with me from Ohio a quart bottle of ether, half of which had been used in the course of former chemical investigations, and which had been found pure. The bottle was stopped with cork, *through which the evaporation was too slow to be perceptible.* About three months ago, this bottle, by a mistake of measurement by the carpenter in the glass case provided for my chemicals, came in juxtaposition with three quart bottles of pure fusil oil. The latter was contained in glass stoppered bottles, the stoppers covered with bladder. One of these bottles had been opened to demonstrate the properties of fusil oil in connection with spirits, and was replaced without restoring the bladder. After this the odor of fusil oil was very perceptible in the neighborhood of the case. About three months later, the ether bottle was taken, and a portion of its contents used for determining the amount of fusil oil in wines and brandies, when it was at once discovered that the ether itself contained fusil oil. On permitting the spontaneous evaporation of the ether in a watch-glass, the oil was observed in abundant *globules*, the odor was that of amylic alcohol, and the irritating action upon the cuticle of the nose accidentally touching it was very strong. Very pressing official duties prevented a chemical examination by analysis of the oil absorbed by the ether, but the odor was alone sufficient to trace it to the fusil oil bottles. The ether had not been employed until used for the wine and brandy experiments, and had certainly not been meddled with by anybody. The only explanation I can give of the phenomena is, that the bottle of ether standing in an atmosphere of amylic alcohol vapor, had received the latter through the

pores of the cork, according to the laws of the diffusion of gases. If this view of the matter be correct, I can readily imagine how a bottle of ether might come into a position to absorb substances which might prove very injurious in cases of anæsthesia.

Yours, very respectfully,

Charles M. Wetherill,

Chemist, Department of Agriculture.

Mr. Chase resumed the discussion of similar forms and meanings between the Chinese characters and the classical alphabets. While admitting that some of the resemblances might be accidental, he could not believe that they were all so. The pointings in a uniform direction are so numerous, that if the attention of scholars who are able to study the Chinese movements on their own soil could be fully aroused, important results might reasonably be looked for. The general character of these pointings was illustrated by the following remarks.

a. Most of the Chinese syllables that end in the sound of *i* (English ē), are pronounced *i* by some of the natives, and *ai* (English ī) by others, thus indicating the possible provincialism, that established the peculiar sound of the letter i in our language. One of the Chinese characters that represent this sound, resembles a small e in its ordinary form, while in the running hand it has the two forms of our written I and E. [See Plate I, fig. 1.]

b. Some of the Chinese hieroglyphs have both the form and the phonetic value of the modern script. Thus the radical for tooth, Ya, has the form of Y, Tsze, of Z (German *tseth*); Shan, of Hebrew *shin*, and Russian *sha ;* Fow, of German *fow ;* &c. [Pl. I, fig. 2.]

c. Not only are isolated letters found in Chinese, but also combinations of letters in syllables that retain a pronunciation similar to that indicated by the phonetic value of the letters. For example, the syllable *ki* (Eng. kē, or kī), is sometimes written in the following ways, to indicate three different meanings; 𝒢ℰ or 𝒢𝒥, 𝕶𝕰 or 𝕶𝕴, 𝖐𝕹, [Pl. I, fig. 3], and each of these forms can be readily traced to the primitive radicals of which it is composed. The resemblance of the last form to the German 𝖐𝕹, as well as the retention of Chinese names for German letters, is suggestive of the resemblane that exists in the angular character of the Chinese and German texts.

d. The phonetic values of the primitive hieroglyphs, are sometimes apparently retained through a succession of different forms. The Chinese radical Tu, for example, which denotes "the earth," may be analyzed into two simple radicals, one of which corresponds to an ancient form of T, and the other is De Guignes' supposed representative for U, which resembles one of the Egyptian hieroglyphs for O and U. [Pl. I, fig. 13.] This radical is sometimes written in the form of T placed in U, and sometimes like a t connected with a V in such a way as to make an Arabic figure 2. [Pl. I, fig. 4.] Moreover, the root *tu*, in Chinese as well as in Sanscrit, embraced the idea of division among its meanings.

e. Some of the radicals are represented by two or more different forms that are found in two or more different alphabets. Thus the "mouth" radical is sometimes written in the form of Roman ⊎, sometimes of the Greek *Δ*. The word *pi*, "to assist," is written with two Greek *π*'s, accompanied by a Roman P. [Pl. I, fig. 5.]

f. In most alphabets, forms nearly identical are employed to represent different letters, as in English E F; d b; p q; n u; Roman P, Greek *P*, and Hebrew ף. Many of these resemblances are found in Chinese, and a reference to the original hieroglyphs often suggests a plausible explanation of the resemblances.

g. If the fertility of resemblance between the Chinese and other alphabetic forms, is often confusing and puzzling, it is no more so than the similar fertility in systems that are purely alphabetic. Such instances as the employment of X to represent the sounds of T, Ch, and X in the Phenician, Greek, and Roman alphabets respectively, —of P for the sounds of P, Ts, Q, and R, &c.,—are so numerous that there is probably not a single alphabetic form that has not been appropriated at different times to several different letters, and there is not a single letter that does not present in its various forms, analogies to nearly half the other letters of the alphabet.

h. These resemblances are sometimes readily accounted for by their phonetic analogies. Thus L and R, B and P, C and G, sound so nearly alike, and are so often confounded, that one would naturally expect them to be represented by similar forms. But there are some curious instances of remoter affinity. For example, among the oldest Phenician inscriptions, the outline of something like a stone hatchet, is used to represent both D and R. These two sounds are to this day confounded by some of our Indian tribes. Most of the Dakotahs are unable to sound either L or R, and they invariably substitute D for each of those letters. The Chinese Taou, a knife,

with an outline resembling the Hebrew ח, seems naturally connected, both by its form and phonetic value, with the Phenician hatchet-shaped D and R.

i. The use of similar symbols for different radicals, seems sometimes to point to a still older primitive. In this way the supposed Egyptian equivalent for the ש, is connected with the Chinese symbols for Mountain, Mouth, Tooth, and Hand, perhaps through the intermediate idea of piercing, or projecting. [Pl. I, fig. 6. The first symbol is Egyptian, the others Chinese. The third form is employed by the Chinese, both for "mountain," and for "mouth."]

k. An apparent association with other supposed hieroglyphics, may be indirectly traced in some Chinese compounds, when such a connection would hardly be suspected in the simple elements. Thus the letter G in Chinese represents a wheeled vehicle. The Hebrew ג is supposed to have been derived from the outline of a camel's head and neck. The Chinese have a character Ko, which when joined to the radical Ma, "a horse," is pronounced Lo, and signifies "a camel." The same character Ko, when joined to the radical Chay (which is represented by G), signifies "wagon." The form G can be derived even more easily from the Chinese hieroglyphic representation of a vehicle [Pl. I, fig. 7], than the form ג from the hieroglyphic of a camel. There are many other indications that the third letter of the alphabet at first signified "a carrier."

l. Some of the Chinese literal analogues appear to furnish an onomatopoetic clue to the shape of the letters, that is wanting in the significance usually attached to the various ancient alphabets. When we are told that יוד means "hand," and כפ "hollow hand," there seems to be no natural connection between the sound and sense. But when we find that in Chinese, Ya signifies "teeth; the parting branches of a tree; anything forked;" and that its hieroglyphic representative is Y, while Keen, "to gape," is represented by K, the natural position of the mouth when one is gaping, or calling attention to the teeth by signs is represented by the forked portions of those letters.

m. The Chinese characters are not all ideographic. Some of them are evidently combined phonetically, according to fixed rules of spelling, and others may probably, as M. de Guignes suggests, be composed of a number of alphabetic elements, that spell Hebrew, Phenician, and other ancient words. M. de Guignes claimed that he could spell, according to his system, over five hundred Chinese words, but unfortunately he appears to have left no record of any

except the few which he introduces to illustrate his memoir. By means of the few conjectural letters that he has given, a number of words may easily be found that tend to corroborate his views, and although the evidence that they give is by no means conclusive, it is sufficiently curious and interesting to tempt one to farther investigation.*

n. The Chinese writing contains all the elements of the alphabetic letters,—the horizontal line, the perpendicular, the oblique, the hook, the curve, the point,—and to each of these elements it attaches a special meaning. The same reason that leads us to infer the antiquity of an alphabet, from the fact that each of its letters retains a certain significance, would, *a fortiori*, indicate the still greater antiquity of a system that retains a meaning not only for every letter, but for every element of each letter.

o. Through the study of the Chinese hieroglyphs, the number of radicals may be greatly reduced, and an alphabet might perhaps be compiled, no more extensive than our own, from which all the characters of the language could be formed by combination, according to simple rules. The whole number of primitive hieroglyphs does not probably exceed eighty,† and many of these are found only in a few words. At least two-thirds of the words that are given in the Dictionaries of De Guignes and Morrison, appear to be made up of about twenty primitives.

p. It is reasonable to suppose that the earliest efforts at speech would be accompanied by expressive gestures, and that the earliest writing would employ images suggested by these natural gestures. We accordingly find, in all known systems of picture writing, that different portions of the human body occupy a prominent position. And all the organs which have names corresponding to those of the Hebrew letters,—the hand, hollow hand, eye, mouth, ear, head,

* Sir William Jones (Asiatic Researches, Vol. II, p. 373), says: "As to the fancy of M. DE GUIGNES, that the complicated symbols of China were at first no more than Phenician monograms, let us hope that he has abandoned so wild a conceit, which he started probably with no other view than to display his ingenuity and learning." This criticism, flippant as it seems in view of the distinguished scholarship of the French savant, is perhaps justifiable, but the curious coincidences that M. de Guignes has pointed out, especially those between the names of the early Chinese and Egyptian kings, are such as to render it still an open question, not whether *all* the Chinese symbols were Phenician monograms (which no one probably ever imagined), but whether any of them may have been originally formed after the manner of the Egyptian cartouches.

† All the most important ones are given in Pl. I, figs. 19 to 90.

tooth,—are represented in the Chinese hieroglyphics, under a gradation of forms, some of which agree with common forms of the corresponding alphabetic letters.

q. The hand was a prominent hieroglyph with the Egyptians as well as with the Chinese, and in each language it appears to have been employed in some form to represent the sounds of C, G, K, E, and T.

r. The most ancient alphabets exhibit either an entire absence or a dearth of vowel sounds, and it seems probable that the characters that subsequently became vocal were all at first consonantal. The alphabet that was carried by the Pelasgi into Italy, probably about 1400 B. C. [See Pl. I], contained only the vowels A, E, I; hence it has been inferred that these were the oldest vowels. As their forms may all be derived from Chinese characters signifying "foundation" or "support," the idea seems plausible that they were introduced after the invention of other letters, as supports or foundations for the sounds of the mute consonants.

s. Many of the Egyptian and Chinese hieroglyphics exhibit a close resemblance that appears to indicate a common origin. Instances of this resemblance may be found in the Chinese Rad. 8, Tow, denoting "top," or "head;" Rad. 10, Jin, which is usually interpreted "man;" Rad. 14, Meih, "a cover;" Rad. 17, Kan, "gaping;" Rad. 75, Muh, "tree;" Rad. 102, Teen, "field;" Rad. 119, Me, "rice." In nearly every case where both the Egyptian hieroglyphs and the Chinese characters exhibit an alphabetic resemblance, the Chinese resemblance appears to be the closer of the two.

t. Some of the hieroglyphs would represent the same letter in Egyptian and Chinese. Thus the Chinese Kan might be substituted for an Egyptian K [Pl. I, fig. 10]; one of the Egyptian representatives of M, resembles the Chinese Muh, "a tree" [Pl. I, fig. 12, No. 1], or Me, "rice" [Pl. I, fig. 12, Nos. 2, 3, 4]; the serpent L of Egypt [Pl. I, fig, 16], reminds one of the dragon Lung of China; the leafy Sh [Pl. I, fig. 14, No. 2], and the star S, find marked analogues in the Chinese Show [Pl. I, fig. 14, No. 1], and Sing. In one instance at least, two of the Egyptian forms for the letter M [Pl. I, fig. 12, Nos. 5, 6], seem to be accounted for by two forms of the Chinese Rad. 119, Me, "rice." [Do., Nos. 3, 4.]

u. If the supposed derivation of *H* and *θ* from the image of the sun (see Proceedings A. P. S., 1861, p. 8), is correct, an interesting harmony is traceable in the Egyptian, Greek, and Chinese, through the scarabæus which represented the sun, and was also used

for the letters τ and θ,—the rising sun, which was employed both for H and θ,—the Greek words Ἥλιος, θεός,—and the Chinese figure of the sun, which resembled the θ in form. [Pl. I, fig. 32.]

x. The rounded shape of the mouth in pronouncing O and U, makes the open mouth, or the eye, or any other round object, a natural symbol for those sounds. In the Chinese forms that represent mouth, eye, and revolving, may be found fac-similes for nearly all the alphabetic representatives of O, U, and V. Even the curve or hook, which the Hebrew ו was supposed to denote, was represented in Chinese by one of the characters for mouth.

y. The Chinese may perhaps furnish a clue to some lost alphabetic forms, and some unexplained Egyptian symbols. Thus the ancient form of Z is said to have been 耳. These two forms are both employed in writing the Chinese Kung, Rad. 48. [Pl. II, line 7, Nos. 3, 4.] The Egyptian symbol of life, the *crux ansata*, may be readily formed by placing the Chinese Sze, "self" (O), upon Ting, "to support" (T), as if to imply that which is living or self-supporting. This combination is actually employed in the Chinese Yu, "to give mutually." [Pl. I, fig. 15, Nos. 2, 3, 4, 5.] The Chinese characters, Shih, "tongue," [Do., No. 1], and Tsze, "child" [Do., Nos. 6, 7], have analogous forms, and the former is added to the radical Shwuy, "water," to form the word Hwŏ, "living; to vivify." The Egyptian winged sun [Pl. I, fig. 18, No. 4], may perhaps be etymologically connected with the Chinese Seih, "what existed in time past; anciently;" "custom; habit." [Do., Nos. 1, 2, 3.] The Chinese open mouth, "Kow" [Pl. I, fig. 17, Nos. 1, 2], has the same phonetic value, and nearly the same form as the Egyptian K. [Do., No. 3.]

z. In attempting to penetrate the mists of the pre-historical past, it is desirable to make use of every clue that may promise to furnish any guidance. Such a clue has been given us in the names of the Hebrew and Greek letters, and the significance,—partly well established, partly hypothetical,—that has been attached to those names. Plate II exhibits a few of the Chinese forms, which seem, both by shape and meaning, to have the most obvious connection with those employed by other nations.

1.* א. The Hebrew Aleph is said to have denoted "an ox; a leader; a prince." Some writers have supposed that the letter was

* The figures in the following paragraphs refer to the lines that are similarly numbered in Plate II.

modelled from the outline of an ox's head, a supposition that seems somewhat plausible, if we examine the head of the hieroglyphic oxhide in Pl. I, fig. 72. But the Chinese archetypes in Pl. II, line 1, all of which appear to denote either foundation, beginning or head, seem to furnish a more marked correspondence with the most ancient forms of the first letter of the alphabet.

2. ב. Beth, "a house; a place; a box." The Chinese archetypes in the second line denote, 1, "a receptacle;" 2, "an inclosure;" 3, 4, 5, 7, "a mound;" 6, "a house."

3. ג. Gimel, "a camel." The 8th, 9th, and 10th forms in line 3 of the archetypes, are derived from Rad. 16, "a support," and Rad. 8, "a top, or head," denoting "that which supports the head; the human neck; the throat; strong; unbending;" &c. The remaining forms denote either Ting, "to carry," or Keu, "a carriage."

4. ד. Daleth, "a door." The 5th and 6th of the Archetypal forms represent a door; the 1st and 7th appear to have been derived from the outline of a knife or hatchet; the 2d, 3d, and 4th denote a mouth or opening. The 18th Chinese radical is Taou, "sword; knife." [Pl. II, l. 22, fig. 6]. The form of the radical is strikingly like that of the Hebrew Tau, and its name furnishes the nearest monosyllabic approach that the Chinese can make to the pronunciation of the Sanscrit root dal, "to cut; to divide."* The Hebrew טלע, "to cleave," appears to connect these several meanings, and to render it probable that the earliest hieroglyphic representative of the dental sounds was either "a cleaver," or "a cleft."

5. ה. He, "hollow." The archetypes appear to be all traceable to different modifications of Rad. 16, Ke, "niche; support;" and Rad. 21, Pe, "ladle."

6. ו. Vau, "hook." The Chinese forms signify either "hand," "claw," "angular," or "hooked."

7. ז. Zayin, "armor." The 3d and 4th archetypes are forms of Rad. 48, Kung, "work; art." This radical is sometimes represented by a hand. The others may be derived either from the hieroglyph of a hand, or of something carried in the hands,—as a bow, a child, or a shield. That the primitive idea was that of carrying, is rendered the more probable from the relative positions of the Latin, Hebrew, and Greek letters, C, ג, Γ, and G, ז, *Z*.

8. ח. Hheth; meaning doubtful. The Chinese forms may be derived from "table," and "sun."

* Compare Ger. *thal;* Eng. *tale, deal.*

9. ט. Teth, meaning unknown. The archetypes are all employed to represent the sun.* Forms somewhat similar are sometimes used for the mouth. The Egyptian character for "splendor," is sometimes written nearly like ט, and sometimes nearly like the fourth archetype.

10. י. Yodh, "hand." The third archetype sometimes signifies "to put aside; to reject." The other three are different forms of the hieroglyphic hand.

11. כ. Kaph, "hollow hand." The Chinese characters signify "hollow; opening or separating; branching." The first and second forms are sometimes used for a hand in the act of grasping; the fifth, which is one of the modifications of Rad. 75, Muh, "a tree," appears to be the archetype of the sixth and seventh alphabetic K's.

12. ל. Lamedh, "to instruct; expert." The archetypes are all forms of Rads. 9 and 10, which are both called Jin, and are both evidently modifications of a single radical. The ordinary definitions are "man; high;" but "top; head or covering," appears probably to have been the primitive meaning. The same primitive often assumes the form of R [Pl. II, l. 20, figs. 1, 3]. The phonetic connection of L and R, renders it probable that the ideas of "instruction" and "head" may have been associated in the minds of the inventors of the alphabet.

13. מ. Mem, "water." The first three Chinese forms denote "water" or "a channel." The fourth and fifth represent a bud or shoot. The sixth is one of the forms of Rad. 119, Me, "rice," to which reference has already been made.

14. נ. Nun, "fish; snake." Archetypes 1, 2, 3, 4, and 6, are different forms of the Chinese character Nae. M. Abel-Rémusat,† in a letter to Baron Humboldt, treats somewhat fully of its various meanings, all of which seem to involve the idea of flowing, connection, or continuance. The third and fourth forms might easily be imagined to represent fishes or snakes, but it seems more probable that they were derived from the hieroglyph for "water," which is one of most common Egyptian representatives for the sound of *n*. In some Chinese words (the word King, for instance), water is depicted under a gradation of forms, some of which are precisely like the Egyptian. The Egyptian hieroglyph for "Nile" or "river," is made up of two characters, one of which resembles the Chinese Nae, and

* V. *ante*, *u*.

† Nouveau Journal Asiatique, Vol. XI, pp. 273–282.

the other may have been intended for a receptacle or mouth (Coptic Lo). It may, therefore, have been designed to express phonetically the Greek word Νεῖλος. The curved stroke at the right of the sixth form, which corresponds precisely with some of the most common alphabetic N's, forms also the principal part of the Chinese characters Kaou, "air, vapor," and Yen, "a long journey." The fifth figure, Sin, "a heart," would, according to the rules of Chinese orthography, represent a final N, and it may be the archetype of the heart-shaped N in the Punic inscriptions.

15. ס. Samech, "prop." The first figure in line 15 represents a prop or support; the others are forms of the word San or Sam, "three."

16. ע. 'Ayin, "eye." The Chinese word Yen, "an eye," may be the root of 'Ayin. The third archetype is one of the most common hieroglyphs for the eye; the others denote either the mouth, or whatever is round or rolling.

17. פ. Pe, "mouth." All of the Chinese forms in line 17 are employed to represent the mouth. In the Chinese word Too, the primitive which denotes "mouth" or "inclosure," is written in the various forms of ב, פ, P, B.

18. צ. Tsadhi, "locust?" Tsaou Chung, in Chinese, signifies "a locust." The archetypal forms represent a sharp, shrill, "cutting" sound.

19. ק. Koph, "ear." The Chinese characters represent either "ear" or "orifice."

20. ר. Resh, "head." The archetypes are all found either among the forms of Rad. 181, Heĕ, "head," or in the outlined heads of animal hieroglyphs. [Pl. I, figs. 63, 64, 78.] The word Heĕ is as near an approach as the Chinese can make by a single utterance, to the pronunciation of the Hebrew monosyllable Resh. The character P, which is found in lines 17, 18, 19, and 20, is usually employed to represent Rad. 26, Tseĕ. The Tseĕ was an instrument of stone, horn, or bamboo, by which officers were appointed or authorized to act. After having letters engraved upon it, it was cut through the middle; one half was retained at court, and the other given to the person appointed. The same character is sometimes employed for Fow, "a mound," and for Chung, "the middle; within; half," and it forms the principal part of the word Ling, "to order; to enjoin." Chung is commonly represented by a mouth divided by a line passing through its centre.

21. ש. Shin, "tooth." The archetypal resemblances do not point

so strongly to a single primitive, as in the case of some of the other letters. Analogues are found in the characters which represent mountain, mouth, teeth, arm, and water. The alphabetic resemblances between the various forms of M and Sh (lines 13 and 21), would seem to point to "water" as the earliest symbol of the two sounds.

22. ת. Tau, meaning doubtful. The idea of cutting or piercing, appears to be conveyed by each of the Chinese forms. (See remarks on line 4 above.)

EXPLANATION OF THE HIEROGLYPHS ON PLATE I.

(For Nos. 1 to 18, see references above.)

19. Taou. A knife.
20. Tseĭh. A battle-axe.
21. Kow. A mouth.
22. Yew. Hand.
23, 24. Yue. Moon.
25. Neu. Woman.
26. Tsze. Child.
27. Shan. Mountain.
28. Chuen. Channel.
29. Kung. Bow.
30. Sin. Heart.
31. Wăn. A painting.
32. Jih. Sun.
33. Muh. Wood.
34. Moo. Mother.
35. Ke. Vapor; spirit.
36. Shwuy. Water.
37. Ho. Fire.
38. Pan. A support.
39. Ya. Tooth, tusk.
40. Neu. Ox.
41. Wa. A tile.
42. Teen. Field.
43. Pih. White; pure.
44. Ming. Dishes.
45. Muh. The eye.
46. Ho. Grain.
47. Leih. To erect.
48. Me. Rice.
49. Chuh. Bamboo.
50, 51, 52. Wang. Net.
53. Yu. Wings.
54. Urh. Ear.
55. Juh. Flesh.
56. Chin. Official cap.
57. Pe. Nose.
58. Kew. Mortar (v. 86).
59. Shih. Tongue.
60. Tsaou. Herbs.
61. Chuen.* Boat.
62. Yen. To speak.
63, 64. Shin. A body.
65. Keu. A carriage.
66. Yew. Liquor.
67. Mun. Doors.
68, 69. Chuy. A short-tailed bird.
70. Yu. Rain.
71. Fe. False (v. 74).
72. Kih. A hide.
73. Heĕ. Head.
74. Fe. To fly.
75, 76. Show. Head.
77. Heang. Fragrance.
78, 79. Yu. Fish.
80. Neaou. Bird.
81. Mang. Frog.
82. Ting. A tripod.
83, 84. Tseŏ. Sacrificial cup.
85, 86. Che. Teeth.
87, 88. Lung. Dragon.
89, 90. Kwei. Tortoise.

* The first form is Chinese, the second Egyptian.

In the varied character of the resemblances that have been thus briefly pointed out, extending, as they do, not only to all the customary forms that are found in memorial inscriptions, but also to the modern running hand, there seems to be a mass of circumstantial evidence, which leads almost irresistibly to the conclusion that the whole history of the invention and gradual perfection of alphabetic writing, must be still preserved in the literature and monuments of China. Of the antiquity of the Chinese Tsaou Shoo, or cursive script, and the recent introduction of similar forms into our own writing, there can be little doubt. It seems to be established beyond any reasonable cavil, that the former has been in use for at least two thousand years. There is a noteworthy coincidence between the date of the Saxon running hand (in the eighth or ninth century), and the Augustan age of Saracen literature and empire, which renders it probable that the learned Mahometans may have communicated to the scholars of Europe, a knowledge of the rapidly-formed letters that had long been used in Asia, and that the advantages arising from their use were so evident as to lead to their speedy general adoption.

Extracts from a letter were read from Prof. J. D. Whitney, geologist of California, relating to the survey of that State, promising the publication soon of one or two valuable volumes of reconnoissance, to be followed by special reports in due time, at the order of the Legislature. "Our results," Mr. Whitney writes, "are, I think, likely to interest the geological world quite strongly. We have found the geology of California to be very different from what it had been represented to be by the Pacific Railroad geologists." Mr. Whitney expects to spend the spring months in additional field-work in the Sierra Nevada, before publishing.

Professor Lesley communicated a notice of a remarkable coal mine or Asphalt vein, cutting the horizontal Coal-measures of Wood County, Western Virginia.

Mr. Lesley said, that through the kindness of R. H. Gratz, Esq., of Philadelphia, a descriptive letter and a map had been submitted to him, which exhibited geological facts of more than ordinary interest to those who are studying the origin of the rock-oil deposits of the West. This letter agrees with previously received, but vague, reports of a true vein of bituminous coal or bitumen. The curious points of the case require careful investigation; but there seems to be no good reason to doubt the essential correctness of the statement.

The mine is situated on a four hundred acre tract of woodland (oak, elm, maple, walnut, &c.), the position of which, in relation to the rivers and railroad of the neighborhood, will be best shown by the accompanying map. Plate III. It may be well to premise a few words about the coal-measure region in the heart of which it lies.

By referring to any map of all Virginia, it will appear that the North and South Branches of Hughes River unite and flow into the Little Kanawha about thirteen miles (in a direct line) above its junction with the Ohio at Parkersburg. The mine itself is somewhat over twenty miles (in an air line) southeast of Parkersburg, and a little under eight miles in an air line, south 4° west (both true and magnetic), from the bridge of the Parkersburg Branch of the Baltimore and Ohio Railroad over the North Branch of Hughes River.

Two peculiarities mark this "coal vein." 1. It is vertical, while all the stratification of the country is nearly horizontal; and strikes S. 78° W. (N. 78° E.), whereas the strike of the country is S. 35° to 40° W. (N. 35° to 40° E.) 2. It is a solid bitumen-vein rather than a coal-bed.

1. The country of the neighborhood is that of the central part of the great synclinal, which crosses the Ohio below Pittsburg, and stretches down through Western Virginia parallel to the Ohio River, into Eastern Kentucky. Across this broad and flat synclinal of coal-measure rocks there flow from southeast to northwest, to fall into the Ohio successively, beginning at the north, the branches of the Little Kanawha, of the Great Kanawha, the Guyandot, the forked branches of the Great Sandy, (and then in Kentucky) the headwaters of the Kentucky, the headwaters of the Cumberland, and finally in Tennessee, the headwaters of the Caney. All these fan-shaped water-basins have their highest or southeastern limit defined

by the strike (N. E. and S. W.) of the more upturned rocks of the southeastern side of the synclinal. With the exception of the Great Kanawha main stream, a line drawn along so as just to touch the extreme tips of all the outermost twigs of these water-trees, will give the southeastern limit of the great Alleghany Mountain or Cumberland Mountain coal area. Their waters collect in flowing northwest, break through the central measures and higher coals of the synclinal, and either join the Ohio (which flows along the depression between the upper and lower coal systems of the True Carboniferous), or the Kentucky and Cumberland Rivers further south.

From this short description it may be inferred, and it is a correct inference, that this belt of synclinal, is in great measure an irreclaimable mountain wilderness; a labyrinth of narrow hog-back ridges and steep, deep, winding vales, providing spaces for agriculture only along the narrow margins of the principal streams, and at here and there a little upland plain, caught in between the head-waters of half a dozen fan-shaped systems of drainage; but all the rest covered with an everlasting forest, folding over the furrowed face of the earth. The region consists in fact of myriads of secluded glens, surrounded by stair-like cliffs from four to eight hundred feet in height, and separated by spiculæ of mountain, which shoot out from the more central water-divides, like crystals of ice over the surface of a pool. The extremely tortuous course of the principal streams is illustrated by the map. They do not flow from side to side of wide, flat valleys, but around sharp mountain prongs, which point across towards opposite open ravines or valleys of considerable length. These prongs descend from the dividing high lands, like the spurs of the Pyrenees from the central ridge, but in long steps, the strata being nearly horizontal, and each sandrock in the descending order carrying the nose out further than the one above it. Narrow terraces carry the outcrops of the long steps of the nose, round each side of the prong along the steep side of the valley.

The coal-beds pass horizontally through the pronglike ridges from valley to valley. Some of these ridges run as narrow on top and as regular as railroad embankments, for three or four miles, and in nearly straight lines, between equally straight vales terminating bowl-shaped against some cross ridge.

It is across such vales and dividing ridges, that the Asphaltum vein of Wood County makes a straight course, A B upon the map, "2323 feet long, as at first measured, but since then traced in both directions still further, so that now it is known to extend more than

two-thirds of a mile." Explorations beyond this line have failed to find it. Its outcrop, four feet ten inches thick, was discovered crossing a ravine fifty feet wide at the bottom, and rising on each side with slopes of nearly forty-five degrees. On one of these hillsides at a height of ninety feet, the outcrop showed the same thickness, but at a height of one hundred and eighty-five feet, it was found to be but two feet six inches thick. It is not certain that this diminution is in a vertical direction; it may be lateral; for the slope between the ninety and the hundred and eighty-five feet levels is more gradual, especially upon the western side.

In the bottom of the ravine, a vertical shaft was sunk to a depth of thirty-four feet upon the vein, which continued uniformly four feet ten inches thick, the asphaltum being filled in, pure and clean, without the least admixture of earthy or foreign ingredients, between the smooth and almost perfectly vertical walls of yellowish-greenish sandstone, lying in horizontal layers, through which this gash or fault was once no doubt an open fissure, communicating with some reservoir of coal oil, which still, it may be, lies beneath it undisturbed. The most interesting part of the phenomenon for structural geologists is this gash.

2. The substance which fills this gash-fault in the coal-measures of Northwestern Virginia, resembles the glossiest, fattest caking coals, and has a decidedly prismatic structure; breaks up into pencils, with flat, lustrous faces and sharp edges, but the faces not set at any fixed angles to each other; so that the effect upon the eye is rather that of a fibrous than of a prismatic structure. At the same time there is not the slightest appearance of layers, but the aspect of complete uniformity or homogeneity. Pieces are taken out, it seems, a foot in diameter; and that portion of one of these pieces which I have, shows a plain face on one side, as if it had encountered one of the walls, and is covered with a delicate film of a dead black substance like charcoal dust, which is probably the dust of the vein substance itself.

"Pieces lying at the surface of the ground are said to yield as much oil as specimens taken out six or eight feet down. By the ordinary dry distillation, the substance is reported to yield as much oil as the Albert coal. By a different process, the first and only trial, at which 600 pounds in one charge was used, 44½ gallons of superior oil was obtained. Retorts are now upon the ground."

By an assay made by Mr. B. S. Lyman, of Philadelphia (the amount of hydrocarbon soluble in benzole being about one-half of the

whole) the volatile matter (mean of two assays) was 47.11 per cent., Coke (52.71, 53.07) 52.89; Ash (1.65, 1.81) 1.73.

There seems to be no escape from the conclusion that the substance filling this vertical vein is a product of the gradual oxidation of coal oil once filling the open fissure. It is not impossible therefore that the lower regions of the fissure are still filled with liquid oil; and that we may see in this instance an illustration of the condition of things far beneath the surface of the coal oil regions of Western Pennsylvania and Eastern Ohio. The vast quantities of oil delivered by the flowing, the blowing, and the spouting wells require fissures of this kind, either never opened up clear to the surface, or else once opened and now reclosed, or else filled in with detritus. The different depths at which closely neighboring wells begin to spout or to flow, oblige us to imagine similar fissures at oblique angles. If Sterry Hunt's hypothesis be accepted, that the Corniferous Limestone is the mother rock of the oil, such fissures become still more needful to bring the oil to the surface, from the vast depths at which the Corniferous Limestone underlies the True Coal-measures.

Vanuxem first described the films and buttons of "anthracite," as he called it, with and in the quartz crystals of the Calciferous Sandrock of New York, at the base of the Silurian system. Mr. Hunt describes the veins and fissures of all the limestone, shale, and sandstone members of the great Quebec Group (which is the enlarged equivalent of the Calciferous in New England and Canada) as frequently either lined or filled with a similar substance. Sometimes the varnish lining has cracked in shrinking; sometimes botryoidal masses of it have been left; sometimes hundreds of pounds of it are packed away solid in the crevices. In one exceedingly instructive case the vein of bitumen, inclosed in walls of rock crystal, is itself cut by thin seams of quartz.*

* Hunt in Amer. Journal, March, 1863, p. 163. The force of the argument deducible from this fact, against the igneous, and in favor of the aqueous production of our quartz veins, will be felt at a glance. I cannot but express my surprise that Sir David Brewster should continue to claim as an argument for the igneous theory, the presence of two different elastic hydrocarbon fluids in cavities in topaz, beryl, and diamond, especially in regard to the permanent compression they have effected in the molecular structure of the walls of the cavities, as detected by polarized light. (Trans. R. S. Edinb., XXIII, i.) Yet M. Fournet supports his argument. (Comptes-rendus, LI, p. 42, LIII, pp. 83, 610; Geol. Lyonnaise, Lyons, 1861, pp. 533, 715, quoted by Sir David Brewster.) While M. Elie de Beaumont rests for its refutation on the volatility of the fluids, and the frequency of fluid-cavities in all quartz gangue rock. (Comptes-rendus, LIII, p. 83.) Sir David Brewster says that M. Fournet "has removed this difficulty" (Geol. Lyon., p. 536), but does not say how.

In these older instances of bitumen veins, we see small prototypes of the large vein under consideration.

The point of the phenomenon most interesting to structural geologists is this: Two opposite deductions are possible from the facts as made known, on the one side in favor of the vast antiquity of the coal oil, and on the other side in favor of the recent denudation of the surface. If we have in this vein a deposit of coal oil hardened by time and the absorption of oxygen, it is certain that the cutting out of the ravines across which it lies, must have taken place subsequently; for the outcrop rises to a height of nearly two hundred feet on each side of the bottom of the ravine in which the shaft is sunk. I do not learn from the report whether detached blocks or pieces of the bitumen occur upon the surface, or in the alluvium of the vale below the crossing of the vein. But that is of no consequence to the principle. The valleys which it crosses must be younger than the vein, if the vein was filled with fluid oil. Hunt shows plainly (see Sill. Journ., March, 1863, p. 167), that the oil which fills the fossil casts of particular exceptional strata in the Lower Devonian Formation (as in Bertee Township on the Niagara River opposite Buffalo), must be an original deposit, and not a subsequent infiltration or exudation, inasmuch as it has lined with oxidized bitumen the cavities of the fossil casts in this stratum, and not those in similar strata above and below.

All that we know of the grooving of the surface of our palæozoic areas consents to the great antiquity of the action, whatever that action may have been. To demonstrate the antiquity of the Corniferous coal oil, is merely to give more room for the antiquity of the oil. Yet, the denudation, however ancient we may make it, must still be kept more modern than the antecedent formation of the coal oil and its change to bitumen.

The date of the formation of the oil may be placed anywhere beyond the close of the Palæozoic era, even as far back as the beginning of the Devonian, or even in Lower Silurian times; since the Quebec Group is also the home of oil. The denudation of the surface of the coal areas cannot of course be put back beyond the uplift of that area into the air.

There remain two hypotheses for dating this denudation. One class of geologists, the Cataclysmists, give the date of the uplift as the date of the denudation; make the two phenomena related and dependent parts of one great action. The other class, the Secularists, regard the present face of the country as but the latest phase of an

infinite series, beginning at the uplift and still in progress. An intermediate view, held perhaps by some eclectics, supposes a succession of denuding actions of unknown force and indefinite number.

As to the Appalachian region of the United States, I think that the principal special objection to the theory of one cataclysm (apart from general considerations) has not been mentioned, or at least clearly stated. And yet it seems to me of great force. It is a deduction from the fact that the estuary bed of the New Red deposit, taken as a grand whole, can hardly be regarded otherwise than as a part of the Post Carboniferous denuded surface, and therefore subsequently formed to the great cataclysm supposed by that theory to have produced that surface. For the surface of the New Red is eroded exactly in the style, and in the direction of, and in entire harmony with the erosion of the surface of the Coal; which of course would make the supposed cataclysm subsequent to both. Two cataclysms being therefore required, a new difficulty appears.

Supposing the first cataclysm to have eroded the palæozoic areas, so that the deepest valleys of erosion nearest the Atlantic seaboard could be filled in with New Red deposits, why were these deposits restricted to the New Red estuaries, so well known as to need no description here? Every one is aware that New Red is nowhere seen behind the range of the South Mountain or Blue Ridge. Yet there are plenty of gaps wide and deep enough to let it through. If it had ever been deposited in the great Lower Silurian Valley behind that range, no cataclysm can be supposed to have acted with such consummate skill and completeness, that not a hillock or corner bit should have remained to tell the story of where its outspread masses had originally lain.

If now, to meet this difficulty, the Cataclysmist brings down the date of his first agency to Post Secondary days, and imagines the New Red rocks to have been excluded from the Great Valley because in fact, no such valley, and no gaps leading into it, had as yet been formed, he not only encounters the old difficulty of providing its estuary bed for the New Red, but in addition to that, the awkward statement that the gigantic anticlinals of the Palæozoic age, once made, remained, uplifting their more than Andean or Himalayan masses in the sky, (with all the climatal consequences of such a supposition), during all the ages through which the so-called Pérmian of Kansas, and the New Red, and the so-called Oolite of the Atlantic seaboard, were depositing their layers.

And when he has settled all this properly, the discussion will re-

open upon him in the same form anew, so soon as the denudation of the Cretaceous and Tertiary surfaces come to be regarded as in like manner in harmony with those of older dates.

At Cornwall, six miles south of Lebanon, hills of New Red Sandstone, three, four, and perhaps five hundred feet high, stand, looking in upon the great Silurian plain, like Peris at the gates of a Paradise they cannot enter. If along this line a *fault* has in fact carried the New Red down to the present level of the Silurian plain, the denudation of the two surfaces is nevertheless so far one phenomenon, that in its present condition it is to be explained by reference to actions subsequent to the deposit of the Conglomerate, or uppermost New Red layer, the so-called Potomac marble. But the hypothesis of a fault along the south base of the South Mountain is a pure fiction of embarrassment. If it existed anywhere, it must extend several hundred miles, and be approximately a straight line. The most cursory glance at the geological map of Pennsylvania will satisfy any one that no such fault exists. The succession of spurs of the mountain range forbids it. The gophered edge of the New Red on the Lancaster County limestone forbids it, and shows how entirely superficial the New Red is. No river section shows the fault. It is a pure fiction. The northwest dip of the New Red, against the Azoic mountain range is still a problem to be solved.

The hypothesis of suboceanic erosion, contended against by the geologists of the United States almost from the beginning, is fast losing, if it has not lost altogether its hold upon the European mind. The conviction is well established, which we freely expressed years ago, that the ocean is a builder and not a leveller. Like the quietistic and subjective letter M, which was its symbol in ancient literature, the main, the murmuring Typhon, has always been the absorber, and the mother of multitudes. While the fringe of foaming breakers, the Herculean Hydra, and in fact all river water, the rushing and hissing Typhon, of which the letter S was symbolic, has always been the destroyer, the enemy of the established, the ravager of the surface. It was upon this basis that some *subaerial* cataclysmic hypothesis like that of Professor Rogers came to be favored by those who knew the grandeur of the work which had been done by the denuding force whatever it was, among the palæozoic anticlinals of America; and who felt the perfect harmony which reigned over the whole expanse of the phenomenon, from the Tertiary seaboard of the Atlantic and the Gulf, past the beds of the great freshwater Devo-

nian and Silurian lakes, to the original shores of the Laurentian Continent.

We cannot regard, therefore, without some natural chagrin, the latest treatment of the subject by Professor Tyndale and Professor Ramsay, of England; for these accomplished observers not only take up our own old views with all the empressement of new discoveries, but make what seems to us the very absurd attempt to carry the petty energies of mountain floods and local glaciers up to the work of excavating, not merely lakes like those of Como, Constance, and Geneva, but such seas as Lake Huron and Lake Superior. It is gratifying, however, to see that such views can be refuted by European observers, who have never encountered the phenomenal problems of America. The impossibility that a moving glacier after descending to sea level, should excavate the bed of a lake, and continue to move up and over its farther end, even taking the smallest Alpine lake known for an example, is admirably demonstrated by Mr. Ball in the February number of the London, Edinburgh, and Dublin Philosophical Magazine for 1863. If this be not possible for the tarns among the valleys where glaciers are at home, how can it be possible for lakes and seas, where the existence of glaciers at any epoch is a theory? And how reckless of all consequences must that theory be, which reads an incantation to these icy demons, to accomplish the symmetrical erosion of a triangular area of earth-surface a thousand miles on each side long, the southern angle of which touches the parallel of 33°!

Professor Ramsay calls attention to the remarkable fact that the lakes of Europe and America seem to be confined to the scratched and grooved portion of the hemisphere, and that they are not found further south than the drift, except in Alpine, that is to say, in glacial regions. This is a coincidence, indeed, which ought to harmonize the two phenomena under some theory; but not necessarily subordinate the one to the other as effect and cause. I have no satisfactory explanation to give for the coincidence. The special reasons for the existence of each separate lake can be easily pointed out. The damming back of the waters of the New York Devonian lakes, including Erie and Huron, are due to the gentle northward rise of their floor-rock. Lakes in the same soft Devonian measures, are numerous along the valley of Pennsylvania, at the foot of the Alleghany Mountain, but only where the measures are gently inclined. Lakes disappear from the map as the eye passes southeastward over the more upturned regions. Steepness of dip is hostile to deep excavation.

The reverse is true of erosion above water-level. Steepness of dip is favorable to aerial disintegration, to the dissection of stratification, to the subdivision of one massif into several, and of one hillock into many; hence to the general degradation of the surface under air. But under water the reverse is true.

In the Laurentian and Huronian, Scandinavian or Azoic regions of the North, where distortion and plication have revelled from the beginning to reduce things to anarchy, and where alternate potash rocks and limestones form the boldest contrast of endurance and decay, lakes abound. A clean, smooth drainage system, worked out so completely (without stating the agency) as to leave no holes, nor cul de sacs pointing in the wrong direction, nor crooked lakes, is possible only when the stratification is clean and in good order, cutting equally and smoothly in all directions according to the force, and permitting the law of compensation to have free course in the establishment of a common and gently declining niveau of reference to water-level. But any conceivable erosive agency, cataclysmic or secular, must encounter a million contretemps, in smoothing off its work over a country like Canada, where no outcrop runs far without doubling like a hare. Sir William Logan has shown that the crooked lakes and lake-like rivers of that country conform to the plications of the primary limestone belts.

Mr. Ball's own hypothesis of an original fault structure for the lake system of the Alps is not new, and is open to as much objection on other grounds, as the theory of Professor Ramsay which he overthrows. If applied to the Devonian lake system of New York and Pennsylvania, and therefore, of course, to the thorough-cut valley system of the Carboniferous plateau of the Alleghany Mountains of Northern Pennsylvania, it will not find a fact to stand upon. Not a trace of fault structure is to be seen over all that immense region; yet the erosion is in straight lines, north and south, and from five hundred to a thousand feet deep. Also not a trace of *original* glacial action can be found. Diluvial striæ are rare; moraines and taluses are wanting. Not one has yet been recorded, if any exist, nor have I ever seen throughout that region, any resemblance to one which did not resolve itself on examination into a barrier outcrop, slightly masked by soil or local drift; and even instances of this kind are rare.

On the other hand, throughout that whole region, the Lyellist can find no evidence of a slow wear and tear through the ages. The region is swept too clean for that. There are no piles of detritus, no

cones at the mouths of ravines, no plains of sand and clay, no deltas at the embouchures of streams and heads of lakes, such as, in the Auvergne, and in the Alps and Pyrenees, impress the traveller with an instantaneous and irresistible conviction of slow wear and tear. On the contrary, the walls of the valleys, high as they are, are vertical bluffs, alternating with taluses of angular blocks fallen from them; the bottoms of the valleys are clean; the lakes have steep shores, and the plains are covered with the disintegration of their own rocks. Everything one sees tells one story, and that the story of a cataclysm which, at one sweep, accomplished valleys, plains, and lakes, leaving next to nothing for all coming time to do, but to protect the surface with vegetation, and to send an annual contribution of the meanest value by the rivers to the sea.

Two systems of valleys characterize the result, as we now study it. One parallel with the coast, and produced by the sweeping away of the tops of anticlinals from one to twenty miles wide and miles in height; the other a transverse system of river bottoms, sunk some few feet or yards below the longitudinal valley which they cross, and of deep, clean, straight gaps through the bounding mountains. It is demonstrable that these two systems are but two parts of one, and owe their origin to the same agency, and at essentially the same time. The peculiar relationship of the rivers to the gaps is sufficient of itself to prove this. Not a fault has been demonstrated in any of these gaps. One fault transverse to the Tussey Mountain occurs *near* one gap, that of the Juniata, and as if, by its loneliness and excentric position, for the express purpose of excepting to such a theory, if at any time one should be presented. It is not until the geologist has passed through the whole region, and has reached its southeastern limit, that he suspects a faulty gap. The Kittatinny or North Mountain is said to be faulted at the Delaware Water Gap, and at the Susquehanna; but so the Sharp Mountain was said to be faulted at the Swatara Gap, until careful instrumental work proved that the coal-beds on each side of the gap were not a hair's breadth out of line. A fault at the Susquehanna is evidently absent, for the very outcrops of the different sandrocks can be traced, at low water, from side to side. And the fault at the Delaware Water Gap is, I believe, nothing but an effect of perspective upon the eye, produced by the inclined lines of cliff, unsymmetrically wrought out on the two sides of the gap, because the cutting force worked in a curve, produced by the presence of the expiring Red Hill anticlinal on its northern slope.

No. The excavation of the Appalachian surface has not been determined by transverse faults; but entirely by longitudinal flexures; and has not been accomplished by glaciers; nor by rain and river water; still less *sub oceano*. By what then? I think much must be discovered before the question can be answered, if we reject subaerial deluge action. What for example do we know yet of the internal structure of those deep diluvions or alluvions which occur in our transverse river-bottoms, where they cross the longitudinal valleys of Devonian olive shale? They seem to be ancient lakes, excavated at the time the topography of the valleys and mountains was determined, and filled with river trash. As they occur in the transverse river valleys, they seem to own the rivers for progenitors. But being in line with the gaps, the occupation of them by the rivers seems, on the contrary, to be as fortuitous as the river-occupation of the gaps. Moreover, the present rivers are evidently the degenerate representatives of grander floods, and the silt of these depressions, judging by the surface, is of too gross and hasty a nature for collection by less than such original deluges. But supposing this also to be a fancy, what relation does the glacial hypothesis, which presumes to annul the necessity for a cataclysmic eroding agent, propose to bear to parallels of latitude?

Wherein does the valley of the New River or Kanawha differ from that of the Susquehanna or Delaware, except in having no New York corals or Canada syenites among its pebbles. In every structural feature they are alike; and like the valley of the Tennessee in Alabama. There is no change in the height or constitution or form of the mountain plateau through which they cut. There is no change in the range to the southeast of them which can affect the question; for the Black Mountains of North Carolina, even if liable to suspicion as glacier-bearers, are far enough removed from the New River on the north, and the Tennessee on the south, to be of no account in this discussion. Is the glacial hypothesis prepared to defend its claims in Middle Alabama under the parallel of 33°? If not, then it has no claims to any feature of the Catskill Mountains under the parallel of 43°, except their scratches; to which, so far as the genesis of mountains and valleys is concerned, it is quite welcome. Yet precisely this bonbon Professor Ramsay refuses it; for he maintains (against Dana), that the striæ at the Catskill Mountain House were made by icebergs floating down the Hudson estuary, and not at all by glaciers. There is a disposition manifested of late among the American geologists, of the New England school, to fill each of the

great valleys of the North with a great glacier of its own, naming them the Penobscot Glacier, the Connecticut Glacier, the Hudson Glacier, the Mohawk Glacier, the Susquehanna Glacier, &c. In view of Kane and Hayes's discoveries of the present state of things in Greenland, and for easy accounting not only for such groups of east and west and north and south striæ as appear at Cherry Valley, the Catskill House, and Wilkesbarre, but also for those which cross the polished summits of our highest mountain tops, such as the Penobscot Knob which looks down upon the valley of Wyoming, there is not the same objection felt now as was at first expressed against the Agassizan cope of ice for the hemisphere. President Hitchcock finds its reliquial glaciers in the valleys of Hampshire and Berkshire, and Professor Dana explains the absence of moraines now by the absence of any aiguilles to overhang and shed their stone-slides upon the back, or upon the edges of its subdivided streams.

The thus admitted absence of moraines, and the excuse advanced for it, return us unexpectedly to the starting-point of the discussion, the question. Could ice have fashioned our topography? No one doubts its ability to scratch and groove and polish. Can it excavate? And if it can, what is the limit of its excavating power? Leaving the glacialists of the fixed-ice school and the floating-ice school to settle between them the force, frequency, direction, and exact *modus operandi* of striation, quite sure that they will at least agree on the *date* of the phenomenon *as very recent*, we are left at liberty to revert to those more remote days, when the broad-backed anticlinals rose into the sky higher than any Alpine aiguilles or Andean volcanic cones; to speculate on, 1, Whether they were unbroken vaults; or split along their axes; 2. If split, whether split completely down to water-level, or how far; 3. Whether glaciers could have been then formed at all; 4. Whether, if formed, they could excavate a valley five or ten miles deep into the heart of an unbroken anticlinal; or 5, Do more than polish the central gorge, if the anticlinal were broken; 6. How such a central glacier could escape from such a gorge sideways, or in any direction but endwise, at the limits of the crack; or 7. Fail to leave high walls, alpine ranges, peaks, aiguilles, and moraines behind it when it disappeared.

Surely the glacialist must startle back from such an incredible picture. The great obstacle in the way of topographical science among geologists, has been an innocent ignorance of the titanic postulates upon the ground; and therefore, an inability to reconstruct in imagination the awful vaults of rock which have been removed from over

at least fifty thousand square miles of the surface of the United States, merely along the one belt of the Appalachian Mountains, between the great coal area and the Blue Ridge range. What has removed these massifs? The excavation of a hundred Lake Superiors to the depth of two thousand feet would not present the same difficulties. Either a cataclysmic subaerial deluge mighty enough to do the work, or a series of such deluges following each other until the work was done, or the atmospheric agencies at work on every square inch of the whole area for almost an infinity of ages,—one or other of these three must be the accepted force. Ice may come in for its share of the byplay, at various and very early times (as Ramsay has made probable in Shropshire) as well as in the last days of its glory, the stamp of which we see left upon our outcrop surfaces; but to make it the initial agency of such erosion is absurd. The power of ice could no more have swept those symmetrical palæozoic arches into the Atlantic, than a child could have flown to Loretto with its church. But whatever did accomplish that work, did it all; established the general register of heights; made every mountain a consistent part of the harmonious whole; worked out all the Lower Silurian valleys precisely on one pattern; excavated every Devonian lake from Harvey's Pond to Lake Huron alike; and cut to the same contour the subcarboniferous cliffs along the whole line from the icy Delaware to the sunny Alabama.

Of the seven or more chief points of speculation cited above, that of the split anticlinal is of course the most important. The admirable illustrations of the Austrian survey, which Haidinger and his noble coadjutors have been giving us for several years, repeat with variations all the curiosities of our Appalachian anticlinal structure, which were prepared for publication twenty years ago by the State Survey of Pennsylvania. But being chiefly sections of younger rocks than ours, the Austrian diagrams exhibit a more disturbed surface, so far as regards faults and slips, snapped anticlinals, upshoved synclinals, lapped folds, insertions or knife-edge intrusions of fragmentary strata, &c., while the main features are all the same. This may hereafter be adduced by some one as an evidence of the necessity of assigning quite a modern date to our contortions; inasmuch as disturbances, *relatively* as old (that is, occurring when the palæozoic rocks had as yet obtained no greater consistency and compactness than the newer secondaries or tertiaries of the Alps) ought to have dealt as hardly with those, as the Austrian subterranean forces have dealt with these. But that would be a hazardous conclusion; for the na-

ture of the bottom on which they lie probably determines, more than any other determining cause, the amount of disturbance in the normal curves of an uplift. The lateral thrust of horizontal tertiaries over a ragged bed of already upturned secondaries, or of flat and soft kainozoic strata over an already formed palæozoic topography, cannot result in symmetrical anticlinals and synclinals; and the amount of hitch and catch below, and therefore of crack and shove above, must be proportional, (1) to the roughness of the old surface, and (2) to the thinness of the new formation. But in the case of the Appalachians, both these proportionals are in the lowest ratio: (1) The palæozoic mass is seven miles thick, and (2) It lies conformably on the "azoic," if not on the "hypazoic" surfaces, so far as we can see, or with local exceptions; and there is reason to believe that where this is not the case geologically, it is the case practically; for the Potsdam sandstone, Quebec group, Taconic system or Primal Formation (whichever name we prefer), probably lies upon an already planed off surface of Laurentian primaries. Hence the wonderful symmetry of the palæozoic vaults and basins, the almost total absence of faults (until one goes far south), and the infrequency and smallness of earthquakes.

Hence also the high probability that the anticlinals were unbroken at the crest. A broken anticlinal must, in ninety-nine cases in a hundred, develop a fault. In the south, a system of broken anticlinals have developed a magnificent system of parallel faults. If the symmetry of our northern anticlinals is the *first* argument against their being originally broken, the absence of faults is a *second*; a *third* is to be found in the many instances of unbroken small anticlinals, unbroken even when overturned and collapsed; a *fourth* is to be found in the absence of any trace of a break in the symmetrical end mountains, formed by the closing of the outcrop walls of an anticlinal valley at both ends of it; a *fifth* is to be found in the side gap structure, which universally accompanies and characterizes the anticlinal structure; a *sixth* is to be found in the total absence of lakes along the anticlinal axis; a *seventh* is to be found in the evident compensation for room lost by room gained along any given cross section.

At this last point I think lies the solution of the problem. A true section of the crust, transverse to the waved structure, would show a perfect compensation between the sum of the outside and inside curves of the side by side lying anticlinals and synclinals; such a compensation as would distribute the slip between the rock faces, or back-and-belly planes of the stratification, through the whole mass, and thereby reduce it at any given point to a minimum. This dis-

tribution of the slickensides movement, taken into connection with the crumpling up into subanticlinals, and the tongue-shaped crimpling of the softer measures inside of these*, must have relieved the strain upon the outside of the synclinals below and anticlinals above, and set quite aside the necessity for those yawning gaps which are supposed by many to have occurred along all the great anticlinal axes of the region. It may be safely taken for granted, that had such occurred on the upper side of the anticlinals, similar ones would have occurred on the under sides of the synclinals, of which we see no trace. That the slipping of stratum upon stratum has gone on everywhere is everywhere evident. The softer formations have been most injured by it, and are penetrated by crumplings when the harder strata have splintered and fissured. But, as a whole, the plicating energy must have acted with a steady evenness of thrust, which carried up the anticlinal waves of the crust unbroken, and in some cases to a height of between five and ten miles above the present surface level.

By what agency could these masses have been removed, without leaving Alpine ranges, with serrated summits and protuberant spurs? Can we imagine the Pyrenees to be reduced by ordinary atmospheric erosion to the condition of the Jura? Giving even infinite time, will the desired result be ever attained? On the other hand, given a homogeneous element with sufficient force, acting either by one or by repeated blows, the result as we now see it on the present ground was demonstrably certain to come from the conditions which we see to have existed on the former ground. No one will deny that water, if obtained in sufficient quantity at a sufficient velocity, would be such an agent. In the acknowledged instability of the crust of the earth, and in its acknowledged less stability in ancient times than now, we find the possibility, nay, we feel the certainty, that the oceans have at times been launched across the continents, and we need nothing more to satisfy all the conditions for an explanation of Appalachian topography.

Parts of a private letter from Leo Lesquereux, Esq., of Columbus, Ohio, were read respecting the fossil botany of the coal, and the publication of manuscript memoirs in prepara-

* See Plate V for a few instances of this structure as yet unpublished. Many others, even more instructive, can be obtained in our various collieries. The western edge of the Broad Top basin is remarkable for the number, symmetry and regular sequence of these tongues; but they are common to all the anthracite basins. Fig. 5 is an accurate representation of one near Beaver Meadow.

tion to illustrate it; and also respecting the character of the Millstone Grit or Subcarboniferous Conglomerate in the Far West. Of the first he says:

If it is finished according to my original plan, it should have at least one hundred and fifty plates. There is no fossil flora of the coal; that is, there is no work on the subject, where one can find figured and described all the species of any coal-field. All has been made by fragments. Brogniart's fossil flora is not half finished, and will not be continued. Lindley and Hutton have published plants of all the palæozoic rocks of England, but all is mixed there, and no part is complete. Göppert has all his published fossil plants disseminated through a number of books, of which no one contains a complete series. Now, for the fossil flora of our coal-measures, I would like to publish drawings and descriptions of all the species, even if these species are already known and published from the coal of Europe; for a double purpose: firstly, in order to enable the student to proceed in the study of our fossil plants without the cost and incumbrance of a large library, which is now impossible; and secondly, to show from the beginning of the vegetation of our earth, the remarkable similitude of American with European types, always broken by characters of dissimilarity as difficult to appreciate now, as they were at the epoch of the coal. . . . It is an entirely American and original work. . . . You well know that everything has been, so to say, put in my hand for such a work. After the Pennsylvania survey, I have had those of Kentucky, of Arkansas, of Illinois, Indiana, Ohio; this last on my own cost. All the best collections of fossil plants of the United States have been sent to me for examination and classification, and thus I have seen an immense number of specimens, without counting those which I have collected myself. Would it not be wrong to abandon and lose the result of a work of so many years, and the advantage of so fine an opportunity for study, and leave the work unfinished, merely because I do not know how or when it can be published? I will go through if I can, or as long as I can, and if the work is good, it will come out in some way, even if I am not more of this world. . . .

I do not send you now the plates of the fossil plants of the Tertiary, ten in number. . . . All the Tertiary fossil plants that I have had under my examination, those of Mississippi, of Kentucky, and of Vancouver's Island, would make about fifteen plates. . . . Some questions of true scientific importance might

be discussed with their publication: 1st. The relation of the actual flora with that of the Tertiary. 2d. The comparative identity of typical forms both on the Pacific and Atlantic shores. By comparative identity I understand relation of the now living plants on both the Atlantic and the Pacific shore, with the fossil flora of the same country; the relation of the Vancouver Tertiary with the California flora, and the relation of the Tertiary of Mississippi, &c., with the Atlantic flora. Of course this does not indicate a relation of vegetation between both sides of the continent, either at the Tertiary epoch or now; on the contrary. 3d. The difference of flora of Europe and of America, at the epoch of the Tertiary, showing the separation of both continents. You know that Heer argues, on a supposed but unreal identity of typical forms at the Tertiary time, and concludes in favor of a Continental connection, either by an Atlantide, or something of this kind. 4th. The relation of forms of the Tertiary and Cretaceous floras, &c., &c. . . .

With this letter I send you two sections of the Arkansas conglomerate measures, and the underlying subcarboniferous measures. I am, indeed, very sorry that my sections were not made with more details and exact measurements; but I am not answerable for the deficiency. My assistant, Mr. Cox, had charge of the geological part of our explorations, and . . . we had for our measurements only an aneroid barometer, which, though pretty good, gave us only approximate altitudes.

The first general section, showing the true position of the coal in relation to the inferior strata, was taken fourteen miles southwest of Fayetteville, in Washington County, on the high waters of Middle Fork of White River.

	FEET.	INCHES.
1. Millstone grit in alternating beds of coarse, gritty sandstone, conglomerate hard sandstone with small pebbles, ferruginous hard bands, and soft shaly sandstone and shale, .	300	
2. Gray laminated shales passing at some places to ferruginous, very hard conglomerate. Shale band, . . .	2	
3. Coal, ...	1	6
4. Hard, black fire-clay full of stigmaria, passing at the base to clay-iron ore, ...	6	
5. Hard limestone with Encrinites, Terebratulæ, Archimedes, &c., &c. Upper Archimede limestone. It appears to be united with the lower bed sometimes, and then thickens to 20 feet, ...	10	
6. Blue soft shales with pebbles of carbonate of iron, . .	20	
7. Shaly sandstone (gray metal of the miners), . . .	30	

8. Hard coarse limestone, with great abundance of the same fossils as the upper one,	10	
9. Cherty limestone, mostly hard silex,	6	
10. Coarse sandstone with plants, Stigmaria, Sigillaria, Lepidodendron, &c.,*	60	
11. Coarse limestone, lower Archimedes bed or middle bed?	30	
12. Coarse and soft brown sandstone with a great number of fossil shells (Knob sandstone?)	100	
13. Hard black limestones with fossils,	40	
14. Black and yellow shales with carbonate of iron (Devonian?)	40	

The second section is that of the Millstone Grit, and is taken from the base to the top of the Horsehead Mountain, a part of the Boston Mountain in Johnson County. It is,

	FEET.	INCHES.
1. Calcareous shales and argillous sandstone, containing a quantity of fossil shells. The top of the hill is covered, and apparently has a stratum of conglomerate; at least loose pieces of conglomerate are found above the exposed fossiliferous shaly sandstone. From top of hill down,	30	
2. Compact and shaly sandstones in alternating beds,	120	
3. Massive, coarse, gritty sandstone,	80	
4. Shaly sandstone, sometimes in banks, covered with vermicular impressions, and cut by hard bands (ferruginous shales),	120	
5. Coarse, gritty sandstone, with conglomerate at the upper part. The pebbles are small, not larger than a bean,	20	
6. Hard, compact, gritty sandstone in banks, alternating with shales and shaly sandstone,	520	
7. Red, yellow, and soft ferruginous shales and shaly sandstone,	150	
8. Gray, hard, micaceous shales, mixed with pebbles of carbonate of iron, and having fossil plants especially near the base, from 10 to	70	
(These shales at Horsehead have at some banks only six feet, at others as high as seventy feet. They pass to sandstone at the upper part.)		
9. Black, soft, earthy shales,	1	
10. Coal, 10 inches to	1	6
11. Fireclay, black, hard, full of stigmaria to level of the creeks.		

* In Illinois, the sandstone has the same plants, and is overlaid by one bed only of the Archimedes limestone. In Indiana, where this sandstone is absent, it is replaced by a thin bed of coal just under the upper Archimedes.

Remarks concerning the nature and variety of the Millstone Grit of Arkansas, are noted many times in my diary. Thus, I read: Passing the hills or divide between the affluents of White River, I find the Millstone Grit of still more varied appearance. Sometimes it is a coarse, hard sandstone, a compound of fine grains of quartz, true millstone grit very hard, and in thick banks. These are separated or underlaid by soft, easily disintegrated, shaly sandstone, and thus they break in large massive banks or pieces thrown down along the slopes of the hills, or in the narrow valleys. Sometimes the same formation is mostly a compound of shaly sandstone, alternating with ferruginous shales, separated by thin beds of clay iron ore, or even of hard fireclay, without any trace of conglomerate. Sometimes the sandstone becomes black, ferruginous, and is here and there cut by a narrow *streak* of conglomerate, whose quartz pebbles are rarely larger than a small hazel-nut, generally much smaller. The Millstone Grit-measures are far more persistent in their thickness in Arkansas than in the East, and as the top of it has not been seen anywhere, the highest mountains being too low, it may be supposed that its thickness is greater than it has been measured at Horsehead Mountain.

Of course, though the variety of appearance and the great thickness of the Millstone Grit of Arkansas can be compared with some parts of the coal-measures of Nova Scotia, referred by geologists of that State to true coal-measures, we cannot conclude an identity of formations. From what you published in the Proceedings of the Society, I agree with you, and readily believe that the Nova Scotian basin is a separated member of our great American coal-fields. The flora of both the Canadian and the United States coal-fields is apparently the same. At least, of all the plants published by Bunbury, too few in number, indeed, to permit a satisfactory comparison, there is now no one that has not been found in our coal-fields. *Odontopteris cuneata*, Bunb., was for many years unknown in our coal-measures, but I have found it in plenty two years ago at Murphysboro', Illinois. This and a few other of Bunbury's species have not been found in Europe. But contrary to our opinion, we have these facts, that the anthracite basin of Pennsylvania is from all appearance the shores of a coal-basin. That Dawson finds in Canada an abundance of fossil coniferous wood; that the English naturalists assert that such wood is also in plenty in the coal-measures of England, while I can find none in ours; that also from Dana's assertion, the fauna of the coal-measures of Nova Scotia is rather related to that of England

than to ours. If it is so, we would have on our continent an anomaly of relation contradicted by what we know from the other formations. Good and long palæontological researches may help to settle the question. . . . .

It is certain that our coal-measures are increasing in thickness eastward, especially for the sandstone and the shale strata. Admitting, if not a continuity, at least a contemporaneity of formation under the same influences, and a continuation of increase of thickness in the same direction and the same proportion, this would already give us many hundred feet of difference for Canada. I understand moreover, that a shore formation of the coal has been necessarily subjected to a great many local variations, which could not reach an inland one. It is clear that the invasion of the sea, bearing with it sand and other materials, could not always penetrate the inland part of the basin, and cover the whole of it. This accounts for the multiplication of strata, and the dividing of coal strata into thin and numerous seams. Of course, if such divisions did happen on the shores, while the internal part of the basin continued in the same state of a continual peat growing, boggy marshes, the vegetation of these partial coal-seams cannot be variable. So local vegetation is always affected or directed by the general one, and the difference of vegetation of our coal strata becomes especially evident, after such cataclysms or such changes of level under the influence of which the whole extent of the coal-measures was covered with deposits, brought by water or formed under it, viz., sandstone or limestone.

It is therefore evident, that even if it was based on well ascertained facts, the sixth objection of Professor Dawson would be of little importance, especially in its application to our coal-measures. But I find it extraordinary to say the least, when compared to other assertions of the same author. In his last valuable paper on the flora of the Devonian period (Quarterly Journal, November, 1862), he says, page 328 : "Some species which appear early in the Devonian period, continue to its close without entering the Carboniferous; and the great majority of the species, even of the Upper Devonian, do not reappear in the Carboniferous period, but a few species extend from the Upper Devonian into the Lower Carboniferous, and thus establish a real passage from the earlier to the later flora. The connection thus established between the Upper Devonian and the Lower Carboniferous, is much less intimate than that which subsists between the latter and the true coal-measures. Another way of stating this is, that there is a constant gain in the number of genera and species,

from the Lower to the Upper Devonian, but that at the close of the Devonian, many species and some genera disappear. *In the Lower Carboniferous, the flora is again poor, though retaining some of the Devonian species, and it goes on increasing up to the period of the Middle coal-measures, and this by the addition of species quite distinct from those of the Devonian period.*" Is not this acknowledging a continual change in the vegetation of the coal epoch, from its beginning to its end? for we cannot admit of course that according to the views of Professor Dawson, such a change has taken place in the Lower Carboniferous, to stop at once at what he calls the Middle coal-measures. And can we not then conclude that with careful and long researches, at such places where the stratification is perfectly well fixed, these changes of vegetation may be recognized in strata of different horizon, and thus used for comparison at other localities?

The discussion concerning the *true Carboniferous measures* is, as you say, tedious and useless, at least when it is made without comparison with what we have around us. . . . . It is certain that the plants of the red shales (Vespertine or Ponent of Rogers), are different from those of the *coal-bearing* measures. There is, indeed, a gap in the vegetation between the *Red shales* and the Conglomerate, even near their horizontal line of union at Pottsville, while in the West, the true coal vegetation descends as low as the Upper Archimedes limestone, or even lower. This anomaly is to my persuasion merely apparent, or the result of causes without connection with the stratification. The vegetation of the coal must be always considered as a peculiar, and if I can say so, as a local one, born and continued under peculiar influences, and thus without a necessary specific connection with that of the open and dry land; a true peat or bog vegetation. I have many times taken the trouble to compare the vegetation of our peat bogs with that of the country at large, to show how the first one would be insufficient to give us even a slight idea of the last. Now the shales of the Old Red sandstone were evidently formed by open extensive flats, alternately covered with water or left dry, and thus, having a peculiar vegetation far different from that of the Bogs, which were always under the influence of a continual internal and external humidity. Compare, for example, the vegetation of the flats of Holland around Groningue, with that of the peat bogs of the same country, and seen just near the border of the same flats. There is not a single species common to both formations. The same can be said of our coast flats, and in New Jersey, you have the same peculiar difference of vegetation near the shores; the one covering

all the part that is reached by marine water, or rather by the tides; the others beginning in lagoons, where the water ceases to be subjected to alternate changes. Thus it has happened, to my persuasion at least, that there has been formed at some place red sandstone, with peculiar remains of vegetation and coal shales, though inferior in geological horizon with true coal plants. And for this reason, I say, that we have to admit the vegetation of the Old Red and that of the Coal, without putting too great reliance in the data furnished by palæontological botany concerning the age of stratification. But remark that I say this only of the red shales, compared with the coal formation; for indeed, as Professor Dawson says it, the slow change of vegetation in the coal-measures (putting aside the Old Red), is apparent from the lowest coal under the Archimedes limestone, to the highest strata of the coal-measures.

Pending nominations Nos. 481 to 491, and new nominations Nos. 492, 493 were read.

And the Society was adjourned.

Stated Meeting, April 3, 1863.

Present, eleven members.

Dr. Wood, President, in the Chair.

Letters accepting membership were received from F. Forchhammer, dated Copenhagen, March 11th, 1863, and from Max Müller, dated 64 High Street, Oxford, March 14th, 1863.

Letters acknowledging the receipt of publications were received from the Royal Society at Upsal, September 15th; the Royal Geographical Society at Vienna, October 15th; the Royal Geological Institute at Vienna, October 4th; the Society at Wiesbaden, November 1st; the Geological Society at London, January 7th; and the Antiquarian Society at Worcester, March 2d, 1863.

A letter accepting correspondence and exchange of publications was read from the German Geological Society at Berlin, November 6th, 1862.

Letters informing the Society of the transmission of donations for the Library, were received from the C. Observatory of Russia, August 1st; the Royal Society at Upsal, September 15th; the Prince Jablonowski Society at Leipsic, January 6th; and the Society at Wiesbaden, November 11th.

Donations for the Library were received from the Central Observatory, St. Petersburg; Royal Society, Upsal; Royal University, Christiania; Geological and Horticultural Societies, Berlin; Prince Jablonowski Society, Leipsic; Geographical Society and Geological Institute, Vienna; Royal Academy, Munich; Natural History Societies at St. Gall, Wiesbaden, Lausanne, and Strasburg; Pontifical Academy, Rome; S. Bellardi, Turin; S. Bianconi, Bologna; M. Des Moulins, Bordeaux; Geographical Society, Paris; Royal, Royal Astronomical, Royal Asiatic, Chemical, and Geological Societies, London; Royal Society, Edinburgh; Royal Irish Academy; Rev. E. E. Adams, of Philadelphia, and the Bureau of Topographical Engineers, Washington.

Dr. Bache announced the death of a member, Judge Carleton, of Philadelphia, aged 76, on the 28th ultimo; and on motion of Dr. Bache, Mr. H. C. Carey was appointed to prepare an obituary notice of the deceased.

Pending nominations Nos. 481 to 493 were read.

On motion of the Librarian, the following names were placed on the list of corresponding societies: La Société Géographique de Russie, Die Deutsche Morgenländische Gesellschaft, and the Palæontological Society at London.

And the Society was adjourned.

Stated Meeting, April 17, 1863.

Present, thirteen members.

Dr. Wood, President, in the Chair.

A letter acknowledging the receipt of publications was re-

ceived from the Imperial Institute of France, dated Paris, October 20th, 1862.

A letter was received from Henry C. Carey, Esq., dated Philadelphia, April 16th, accepting the appointment to prepare an obituary notice of Judge Carleton lately deceased.

Donations for the Library were received from the Young Men's Association at Buffalo, the Franklin Institute, the Pennsylvania Colonization Society, Blanchard & Lea, Mr. Isaac Lea, Surgeon-General Hammond, and Mr. Leipoldt, bookseller.

Dr. Bache announced the death of Dr. Charles W. Short, on the 7th of March last, aged 68.

The Secretary made some remarks upon the organization of a National Academy of Science, which led the way to a general discussion by the members present of the importance of that class of subjects, which relate to the welfare and improvement of society; such as the trial by jury, the giving of evidence by parties interested, and the proper representation of classes rather than masses in legislation. Mr. Fraley, Mr. Price, and Prof. Coppeé spoke at some length upon these points.

Pending nominations Nos. 481 to 493 were read and balloted for.

No further business being before the Society, the ballot boxes were examined, and the following persons declared by the President duly elected members of the Society:

J. E. Hilgard, Assistant in the U. S. Coast Survey.
Charles A. Schott, " " " "
Thomas E. Blackwell, C. E., London, England.
B. W. Richardson, M.D., London.
Thomas Hill, D.D., President of Harvard College.
William D. Whitney, Yale College, New Haven.
Chester Dewey, D.D., Rochester University, N. Y.
William Henry Green, D.D., Theological Seminary, Princeton, N. J.
James Pollock, Director of the United States Mint, Philadelphia.

E. A. Washburne, D.D., Rector of St. Mark's, Philadelphia.

James McClune, Central High School, Philadelphia.

Calvin Pease, D.D., First Presbyterian Church, Rochester, N. Y.

New nomination No. 494 was read.

And the Society was adjourned.

Stated Meeting, May 1, 1863.

Present, twenty-six members.

Dr. Wood, President, in the Chair.

Letters accepting membership were received from Chester Dewey, dated University of Rochester, April 22d; William Henry Green, dated Princeton, April 26th, and Charles A. Schott, dated Washington, D. C., April 22d, 1863.

Letters acknowledging the receipt of publications were received from Prof. Hyrtl, and the Secretary of the Imperial Academy at Vienna, dated November 1862; the Royal Academy at Munich, October, 1862; the Batavian Academy at Rotterdam, January 21st, 1863; the Bureau des Longitudes at Paris, December 5th, 1862; the Leeds Philosophical and Literary Society, December 31st, 1862; the Library of Congress, April 22d, 1863; and the Smithsonian Institution, July 22d and October 20th, 1862.

Donations for the Library were received from the Royal Astronomical and Chemical Societies in London; the Geological Society of Dublin; the Massachusetts Historical Society, Dr. Dewey, of Rochester, Mr. William Vaux, Prof. Cresson, Prof. Lesley and Mr. Leipoldt, of Philadelphia, and the Smithsonian Institution.

The decease of a member of the Society, Dr. William Darlington, on the 23d of April, at West Chester, aged eighty-

one (within five days), was announced by Mr. T. P. James, who, on motion of Dr. Coates, was appointed to prepare an obituary notice of the deceased.

The Secretary presented the following communication from Prof. Dawson, of Montreal, and, on account of the notice given of an address by Mr. Price upon another subject to which the evening would probably be devoted, moved the postponement of its consideration until the next meeting, which was so ordered.

Dr. Dawson desires, with reference to the rejoinder of Mr. Lesley to his objection to the views of the latter, on the Coal Formation of Nova Scotia, to make the following explanations.

1. Dr. Dawson is not aware that he has, at any time, maintained that the "coal-measures proper" of Nova Scotia are 25,000 feet in thickness. In speaking of their enormous thickness, he referred to the actual measurements of Sir W. E. Logan at the Joggins, which give for the whole of the Carboniferous rocks seen in that section, a vertical thickness of 15,570 feet, and for the coal-measures proper, or Middle Coal Formation, a thickness of rather less than 10,000 feet. The objections based by Mr. Lesley on this supposed thickness of 25,000 feet, are therefore quite inapplicable to the views of Dr. Dawson.

2. Dr. Dawson does not admit the interpretation of his views as to the unity of the coal flora given by Mr. Lesley. The "inconsistencies" alleged by the latter, depend in part on the imaginary thickness of 25,000 feet attributed to the Middle coal-measures. The identity of the flora throughout the Middle coal formation, and the distinctions between this and the assemblages of plants in the Lower and Upper coal formation, admit of being readily ascertained, where good exposures exist, as in Nova Scotia; and it is to be borne in mind that the investigations of Dr. Dawson on this subject have extended over more than twenty years, though many of the details ascertained have not yet been published.

3. It should be understood that the Carboniferous system in Nova Scotia consists of the following members:

(1.) *The Upper coal formation*, containing coal formation plants, but not productive coals.

(2.) *The Middle coal formation*, or coal formation proper, containing the productive coal-beds.

(3.) *The Millstone grit series,* represented in Nova Scotia by red and gray sandstone, shale, and conglomerate, with a few fossil plants and thin coal seams, not productive.

(4.) *The Carboniferous limestone,* with the associated sandstones, marls, gypsum, &c., and holding marine fossils, recognized by all palæontologists, who have examined them, as Carboniferous.

(5.) *The Lower coal-measures* holding some but not all of the fossils of the Middle coal formation, and thin coals, not productive; but differing both in flora and fauna from the Upper Devonian, which in New Brunswick they overlie unconformably.

The principal, though not the only point in which Mr. Lesley differs from Logan, Lyell, Brown, and Dawson, is his entire omission of No. 5 of the above series, and placing No. 3 of the above series in its room, as the representatives of the Lower coal-measures of Virginia and Pennsylvania. I have, I think, already made this sufficiently plain, in the fifth of my objections, already published; but may add here that fossils as well as stratigraphical position establish the real equivalency of No. 5, and not No. 3, to the Lower coal formation, as described by Lesquereux in America, and by Geoppert in Europe; and that it seems strange that Mr. Lesley, while suggesting minor and more dubious parallelisms, declines to admit this identification, established by long and careful investigations of several competent observers, and confirmed by the evidence of fossils.

It is impossible now to enter into the evidence of the conclusions which I have stated in reply to Mr. Lesley. This is, however, in great part before the world, more especially in memoirs published in the Proceedings of the Geological Society of London; and I have, for several years, been engaged in making up for publication the fossil plants collected from all the members of the Carboniferous system of Nova Scotia. This I trust to be able to publish in the course of this year or next, when I think the actual parallelism, as above stated, will be more fully apparent than it can be made at present.

Mr. Price then read a communication upon the subject of trial by jury.

The Constitution of the United States declares, "The right of trial by jury shall be preserved;" and the Constitution of Pennsylvania,

"That trial by jury shall be as heretofore, and the right thereof remain inviolate."

This time-honored institution, as known to us, peculiar to British and American jurisprudence, had the germ of its origin in the forests of Germany, whence it is traced with other features of the Constitutions of England and of these States. It must have been felt to be a bulwark of liberty and justice, otherwise it could not have been so long and so sacredly preserved as our inheritance, through successive invasions and conquests of England, and revolutions there and here, and many usurpations of arbitrary power, to be here made fundamental in the Declarations of Rights contained in our Constitutions.

"Whoever," says Montesquieu, "shall read the admirable treatise of Tacitus on the manners of the Germans, will find that it is from them the English have borrowed the idea of their political government. This beautiful system was invented first in the woods." (Bk. XI, Ch. VI.) Tacitus, after speaking of those general councils of the whole community, which must have been the origin of the Wittenagemote, or British Parliament, says, "It is in these assemblies that princes are chosen, and chiefs elected to act as magistrates in the several cantons of the State. To each of these judicial officers, assistants are appointed from the body of the people, to the number of a hundred, who attend to give their advice, and strengthen the hands of justice." (Sec. XIII.) Divisions of the freemen into hundreds, who attended the hundred court, are of frequent mention in the early laws of France and Lombardy, and they became under King Alfred and his successors, the prevailing system over England; and the name is yet familiar in portions of our own country.

Some have traced the origin of juries to Athens and Rome; but these were more popular assemblages, sworn, it is true, in the cause, but deciding by majorities; and such may have been the character of the Saxon and Roman assemblages, who aided in the administration of justice, and the conservation of the peace. Selden ascribes to the reign of one of the Ethelreds the first mention of a jury of twelve. The law is in these words: "In every hundred let there be a court; and let twelve freemen of mature age, together with their foreman, swear upon the holy relicks, that they will condemn no innocent, and will absolve no guilty person." Selden refers this law to the period of Ethelred who began his reign in 961; but Reeves, in his History of English Law, to a king of that name who next preceded Alfred the Great, a hundred years prior, whom Hume calls Ethered. The transactions of the reign of Alfred, which began in 871, show

that trial by twelve jurors existed in his time, and that an unanimous finding was then required. The Mirror of Justice, written long before the Norman conquest of 1066, reports the following doings by that renowned monarch: "He hanged *Cadwine*, because that he judged *Hackway* to death without the consent of all the jurors; and whereas he stood upon the jury of twelve men, and because that three would have saved him against the nine, Cadwine removed the three, and put others upon the jury, upon whom Hackway put not himself." "He hanged *Freeburne*, because he judged *Harpin* to die, whereas the jury were in doubt of their verdict; for in doubtful causes, one ought rather to save than condemn." Here, a thousand years ago, in distinct lineaments, is seen the jury of our day, with the feature of unanimity of decision, and a sternly purposed immunity from judicial encroachment. (Mirror, 339–40.)

John Reeves, a high Tory historian, ascribes the trial by twelve jurors to Norman introduction after 1066; admits that it had obtained in Scandinavia, at a very early period; went into disuse, was revived about 820, carried by Rollo into Normandy, and thence by the Norman conquest into England. He speaks of a lost act of Henry II, enacting that all questions of seisin of land should be tried by twelve good and lawful men, sworn to speak the truth. (1 Reeves, 84, 86.) But the Mirror of Justice shows that it existed in full vigor nearly two hundred years before, and it is probable that it existed there long before King Alfred's reign.

Hallam says, "It has been justly remarked by Hume, that among a people who lived in so simple a manner as the Anglo-Saxons, the judicial power is always of more consequence than the legislative. The liberties of these Anglo-Saxon thanes were chiefly secured, next to their swords and their free spirits, by the inestimable right of deciding civil and criminal suits in their own County Court; an institution which, having survived the conquest, and contributed in no small degree to fix the liberties of England upon a broad and popular basis, by limiting the feudal aristocracy, deserves attention in following the history of the British Constitution." (2 Mid. Ages, 9.)

Magna Charta was extorted from successive kings of England, in the thirteenth century, and they were made to declare that, "No freeman shall be taken or imprisoned, or disseized of his freehold or liberties, or free customs; or be outlawed or exiled, or any otherwise destroyed; nor will we pass upon him, nor condemn him, but by lawful *judgment of his peers*, or by the law of the land." (Chap. 29.) "By lawful judgment of his peers," means a trial by those of

equal rank and condition; peers of the realm by such peers; freemen of the hundred by other freemen thereof. Such an immunity in ages of violence and insecurity, must have been regarded as of inestimable value, and as no age or country is exempt from the violence of prejudice and excitement, and the partialities of similar social condition, this security of trial by one's peers should forever be regarded as an inappreciable inheritance.

Justice is always administered with the highest satisfaction to the citizen, when he is satisfied with those who are to adjudge his rights. When assured that the jury are his equals, possessing a common interest with himself in the laws to which they are to give effect, he is best prepared to yield his confidence, and to abide by their verdict. Add to this his privilege of striking from the panél so many as measurably to make the residue to be persons of his choice, and he becomes the better satisfied to submit his rights to their decision.

This institution of trial by jury, which since an unknown antiquity has been consecrated in the affections of the only nations of the earth truly free, it is suggested in this age of free inquiry, that spares not the most sacred subjects, may be dispensed with, or essentially modified in its procedure. The first objection to be made to any change of the trial by jury, is that *change* in itself incurs some risk of loosening a conservative dependence upon long-established and venerated practice, and that the work of reform once begun may be carried to a dangerous excess.

This concession, it is believed, may be safely made: that the parties litigant, when both are agreed, should have the privilege of submitting the facts and the law to the Judge or Judges who are sitting on the bench. This is, indeed, done whenever the party complainant files a bill in equity, or libel in the Admiralty or Consistory or Probate Court, and parties dispense with a jury when they agree upon the facts, and submit them to the Judges to pronounce the law that arises upon them. As parties may agree to refer their controversies to referees or arbitrators, both as to facts and law, so they should be at liberty to make the Judges their referees of both facts and law. To make provision for this would be no invasion of the Constitution, and would demand no change of that fundamental law. By consent, except in capital cases, a party may waive a benefit secured to him by law.

To go further, it is submitted, would be unwise and unsafe, as well as require a change of our Constitutions; and this will further appear by other reasons for trial by jury yet to be noticed. While it is ad-

mitted that it is very important that the parties litigant should have confidence in their Judges, and be willing to hold or lose their supposed rights by their arbitrament, and also that exact justice, as nearly as practicable, should be administered, there are public objects to be attained by this method of trial by jury, of a political bearing, of even greater importance than the interests of the parties litigant.

Trial by jury is necessarily a public proceeding, and that publicity is the strongest guarantee against judicial favoritism and corruption. The bystanders witness the whole proceeding, and not only they, but through the press, the whole public are the observant critics of every important trial. Thus are the Judges and jury the "observed of all observers," and are undergoing a trial, as well as the accused, or the parties litigant. And thus too, not only the jurors in attendance, but the whole public, are constantly deriving an education in public affairs, and are learning the principles of law by which they hold their property, and enjoy all their rights. This to the mass of the business community is probably the most important of all the education they receive. It is important to themselves in their business affairs; it is more important in their capacity of constituents in a representative government, and in their capacity of possessors of the ultimate sovereignty of their country. It is their needed training as a free people, to enable them to appreciate and maintain a free government; and to perpetuate it, as they have inherited it, to future times. Supersede this system by cheaper modes, and more secret proceedings, then all this participation of the people in the administration of justice, so fraught with useful instruction to them, and we shall be on the road to national declension, and soon lose those characteristics which make us a nation of freemen.

Again, Judges who are not the appointees of a power, absolute by the standing armies it controls, could not sustain themselves in the public confidence, if under a compulsion to decide both facts and law, and especially if their proceedings were in written depositions and pleadings, and but little discussed before the public. Too many parties would be disappointed litigants, conceiving themselves injured, not to make a large aggregate of hostile feeling against Judges, who must decide many hundred causes in each year, and in each cause making one party unfriendly if not hostile. With the assistance of juries, the Judges escape this injustice which proceeds from disappointed expectations. The jurors are suddenly called from the mass of the citizens, for a few weeks exercise this terrible power of

deciding upon the rights, reputations, fortunes, and lives of their fellow-citizens, are dismissed, and become invisible in the community. Thus the whole qualified male citizens in turn perform this high function, and the whole in turn share this fearful responsibility, and divide the resentment that follows disappointed litigation. It then results, as stated by the profound and philosophical Montesquieu, "By this means the power of judging, a power so terrible to mankind, not being annexed to any particular state or profession, becomes, as it were, invisible. The people have not then the judges continually present to their view; they fear the office, but not the magistrate." (Bk. XI, Ch. VI.) This is all the more important where we have in operation a system not only to elect the judiciary after a term of years, but have also constituted some of our Courts judges of elections, and their decisions necessarily become the subject of partisan censure and hostility. To such feeling have some of the best judges been sacrificed, or put in peril of failure in their re-election.

And are not jurors an important assistance in the administration of justice? The best Judges bear testimony that they are. If justice be done to the wheel by placing in it the most intelligent citizens of all occupations, every traverse jury of twelve men should possess an aggregate of practical information, that should be greater than that of the Judge on the bench, however good his legal information, and as a rule, Judges admit this to be their experience as to jury trials. Yet in our city, though the Legislature has sought to remedy the evil, and to place that remedy in the hands of the Judges, there is a failure to get into our jury-boxes the full average of the intelligence of the community. There is an unpatriotic evasion of this most important duty by many citizens, who are willing enough to complain of the delinquency of others, when it becomes their own misfortune to be litigating parties.

Another suggested reform it is that jurors should be authorized to decide by some number less than the whole. The wisdom of coercing a unanimity of decision is spoken of as a relic of the barbarous age in which the trial by jury had its origin. It is said that it is to bring about a verdict, which should be the result of an enlightened intelligence only, by the powers of the respective jurors to undergo physical endurance. This requirement of a unanimous verdict, it is believed, must have proceeded from that jealousy of liberty and desire of security, which influenced the minds of the people who instituted the trial by jury. They thought it best that the accused should not be convicted, unless the case was so clearly

made out as to command a unanimity of decision; and that the plaintiff asserting a claim of property, should not disturb the existing possession, unless he could prove a clear and certain right to recover. It is better to do nothing in a case so obscure as to leave an apparent risk of doing injustice and wrong. The idea is a conservative one.

The evils incident to jury trial, which constitute the objections to it, are reasons against accepting any verdict from less than the twelve. The number of twelve is so great, that it is said too much to divide the responsibility, but when all must agree, each is held to his full responsibility. The ignorance of jurors is so great, it is said, they cannot be relied upon; if so, then a majority vote would surely be the product of that ignorance, while a unanimous vote must include the assent of the most intelligent. It is said different jurors may proceed upon different grounds, each of which by itself would be insufficient, and thus they unite upon a verdict; but a majority verdict would only be so much the more likely to rest upon such insufficient grounds, and to be carried over the heads of those who are acting upon good grounds. A vicious accumulation of different minority views is much less likely to attain a unanimity than to attain a bare majority. It is said jurors are carried away by vulgar and artful advocates, who stoop to practise upon their prejudice, and that large corporations, insurance offices, rich landlords, lawyers, doctors, gentlemen of wealth, or unpopular persons, have little chance of justice with the mass of jurors; then, that they may not suffer actual wrong at their hands, it is of great importance that jurors thus susceptible of being swayed by prejudice, should be required to be unanimous, by which all the dispassionate conservatism to be found in the twelve will be obliged to concur in the verdict. And against the wilful or erroneous action of the jury from the objected liability to bias and prejudice, the power of the court to set aside verdicts is readily exercised to prevent injustice. As the jury in criminal cases is the antagonistic power, to hold in check judges, when too closely sympathizing with an arbitrary executive, so is the court the supervising power, to correct the excesses of the jury. It results, that causes are tried by *judges and jury*. And though there be evils and inconveniences incident to this, as to all other human institutions, and it affords but an approximation to perfect justice, it is believed to be, for the causes to be tried, and the other purposes of its creation, the most perfect and safe that human experience and wisdom have devised. In the unhistorical period that preceded the Christian era, it had its beginning, and ever since has had its growth, and by

gradual usage been improved, and since it is the great distinguishing feature in the administration of justice in the only truly free nations of the earth, and has most essentially contributed to the consummation of that freedom, it should now, it is submitted, be so sacredly regarded as not to be touched by the irreverent hand of legislative innovation. If it can be improved, let that improvement come, as in the past unnumbered centuries, by those changes which practice and usage insensibly produce in all human affairs. Perfect justice is not of human attainment. Perfection is the attribute of Him alone to whom is known all truth.

It is admitted that there have been periods in English history, when the rights of juries were most seriously invaded, and their purpose perverted; when they have been coerced by denial of food and drink, by fines and imprisonment; and when the verdicts rendered by less than the whole twelve have been received by the court, or a recusant minority has been removed and replaced by others. The evil precedents of such times, the friends of irresponsible power endeavored in vain to perpetuate as authority. In the reign of Edward I, extending from 1272 to 1307, the writer of Fleta lays it down for law, that when there was a difference of opinion among the jurors, it was at the election of the judge either to afforce the assise, by adding others until twelve were found who were unanimous, or to *compel* the assise to agree among themselves, by directing the sheriff to keep them without meat or drink till they all agreed in their verdict. Another method was to enter the verdict of the major and lesser part of the jurors, and the judgment was given according to the verdict of the majority. (2 Reeves, 268; 2 Hale's Pleas of the Crown, 297, note.)

Hallam, when speaking of the prosecutions of the Crown, in the reign of Elizabeth, says, "There is no room for wonder at any verdict that could be returned by a jury, when we consider what means the government possessed of securing it. The sheriff returned a panel, either according to express directions, of which we have proofs, or to what he judged himself of the Crown's intention and interest. If a verdict had gone against the prosecution in a matter of moment, the jurors must have laid their account with appearing before the Star-chamber; lucky, if they should escape, on humble retractation, with sharp words, instead of enormous fines and indefinite imprisonment. The control of this arbitrary tribunal bound down and rendered impotent all the minor jurisdictions. That primeval institution, those inquests by twelve true men, the unadulterated voice of

the people, responsible alone to God and their conscience, which should have been heard in the sanctuaries of justice, as fountains springing fresh from the lap of earth, became like waters constrained in their course by art, stagnant and impure. Until this weight hung upon the Constitution should be taken off, there was literally no prospect of enjoying with security those civil privileges which it held forth." (1 Const. Hist. of Eng. 315.) He further says, "I have found it impossible not to anticipate, in more places than one, some of those glaring transgressions of natural as well as positive law, that rendered our courts of justice in cases of treason, little better than the caverns of murderers. Whoever was arraigned at their bar was almost certain to meet a virulent prosecutor, a judge hardly distinguishable from the prosecutor, except by his ermine, and a passive, pusillanimous jury. Those who are acquainted only with our modern decent and dignified procedure, can form little conception of the irregularity of ancient trials, the perpetual interrogation of the prisoner, which justly gives us so much offence at this day in the tribunals of a neighboring kingdom, and the want of all evidence except written, and perhaps unattested examinations or confessions." (1 Const. Hist. of Eng. 312.)

It was under the reigns of the arbitrary Tudors and Stuarts that bad precedents were most made and followed, and juries were most coerced by hunger, thirst, fines, and imprisonment, but this course of tyrannical procedure was in a great measure brought to an end by the trial of William Penn and William Mead, at an Oyer and Terminer Court, held in the Old Bailey in London, in 1670, and in the hearing of Edward Bushel, one of the jurors, brought up from prison on Habeas Corpus, before the Judges of the Common Pleas. On the trial of Penn and Mead, they were rudely and insolently treated by the Court, but they as resolutely maintained their rights, and those of the jury under Magna Charta. The charge against those Friends was the holding an unlawful and tumultuous assembly in Grace Church Street; where they had but assembled to worship God as near as they could to their meeting-house, which the civil authority had closed against them. The jury, some of whom had caught the liberty-loving spirit of Penn, after deliberation, declared that they could not agree. The uncomplying four were ordered into court, one of whom was Bushel, and after being roundly abused, retired again to deliberate, and returned with the verdict as to Penn, "Guilty of speaking in Grace Church Street;" and as to Mead, "Not guilty." This was an unavailable verdict as to Penn. The recorder abused

the jury for being led by Bushel, and said to them, "You shall not be dismissed till you bring in a verdict which the court will accept. You shall be locked up, without meat, drink, fire, and tobacco. We will have a verdict by the help of God, or you shall starve for it." The contest lasted from the 1st to the 5th of September, and ended in the jury finding a verdict as to both prisoners of not guilty; in the prisoners and jurors being amerced by the court forty marks a man, and the commitment of the jurors to Newgate. After long and learned discussion of the rights of jurors upon the Habeas Corpus, Chief Justice Vaughan "delivered the opinion of the greatest part of the judges," "that the prisoners ought to be discharged," "because the jurors may know that of their own knowledge, which might guide them to give their verdict contrary to the sense of the court." (Freeman's Reps. 5.)

It is true, that in ancient times, according to the ground of this decision, jurors were taken from the vicinage, that they might act upon their own knowledge, as well as upon the evidence they heard in court; but in this age, of an improved system, it is intended that every cause shall be tried on the evidence heard in court in presence of the parties, yet if jurors have knowledge of facts pertinent to the issue in trial, it is their duty to state such knowledge, and testify as witnesses as well as try the cause. The reason given in Bushel's case, for the right of the jury to find against the views of the court is never heard in the present age; nor would any one deny in this age, the power of the jury over the whole cause, after hearing the charge of the court in criminal causes.

This victory of Penn's jury was gained by a minority of one-third the jurors; first over their eight fellow-members, next over their judges and the Crown prosecution; a victory worth more to human liberty than many ordinary well-fought battles in which thousands are slain.

While yet the Stuarts reigned, Lord Hale, in his Pleas of the Crown, stated the rule as to verdicts to be this: "If there be eleven agreed, and but one dissenting, who says he will rather die in prison, yet the verdict shall not be taken by eleven; nor yet the refuser fined or imprisoned, and therefore, where such a verdict was taken by eleven, and the twelfth fined and imprisoned, it was upon great advice ruled the verdict was void, and the twelfth man delivered, and a new *venire* awarded; for men are not to be forced to give their verdict against their judgment." (2 Hale's P. C. 297.) This decision "upon great advice," was made in the 41 Edward III,

or in 1368; and was thus pronounced to be the continuing law of England by Chief Justice Hale, in the same reign of Charles II, when Penn and Mead were tried, and Bushel discharged; consequently, that all arbitrary proceedings in intermediate reigns at variance with it, had been usurpations.

Unanimity is to be attained, or no verdict results. The jury is to be kept together until they have made earnest efforts at a reconciliation of opinion; but what their verdict shall be, or whether there be any, must depend upon themselves alone. They may be unable to agree, and after due effort, they will in civil cases be discharged by the court, or they may give an erroneous verdict against the weight of evidence, or contrary to the direction of the court in law, and then their verdict in a civil case will be set aside, and the issue be tried by another jury. But the opinion of the jury cannot be coerced.

In the trial of persons charged with the higher degrees of crimes, there is more ground for a charge of a physical coercion upon the jurors. In civil cases, the judge is expressly authorized by statute to discharge the jury because they cannot agree. In capital cases, he cannot merely for that reason discharge them. (6 S. & R. 577; 3 R. 498.) Our Constitution declares, in consonance with the common law, that "no person for the same offence shall be twice put in jeopardy of life or limb;" and to commit his case to two juries is to put him twice in jeopardy. To discharge the jury is, therefore, to discharge the prisoner. This is a discretion that judges disclaim, and it is obviously a dangerous one. But although the jury cannot be discharged because they cannot agree to convict or acquit the prisoner, the judge must act to discharge the jury trying a capital charge, in a case of *absolute necessity;* and that necessity arises when the health or life of a juror is in peril. Chief Justice Tilghman says, "No one can think for a moment that they are to be starved to death. God forbid that so absurd and inhuman a principle should be contended for. Very far from it. The moment it is made to appear to the court, by satisfactory evidence, that the health of a single juryman is so affected as to incapacitate him to do his duty, a case of necessity has arisen which authorizes the court to discharge the jury." (6 S. & R. 587.) And that such necessity may not arise, the court will allow a reasonable supply of food and nourishment, as a right of the jurors. (3 Rawle, 503.) There exists, therefore, in the trial of high crimes, a pressure of physical bearing, namely, of only a seclusion under the charge of a sworn officer, until they agree, or health gives way. And is not this better and safer than that a majority

should quickly find the prisoner guilty of a capital offence, while the minority held a different opinion, or had doubts of his guilt? Is it not better that several guilty persons should escape, than that one innocent should be sacrificed? And what duty is there that is not better performed by some physical sacrifice, and more willingly endured, that the duty is a most responsible one? There are few moral, religious, or legal duties performed under sacrifice of comfort and through abstinence, that are not performed with clearer intellects and a more exalted sense of duty. And when jurors are charged with the life of a fellow-being, what is the suffering of confinement or abstinence compared with their faithful discharge of duty towards him and the Commonwealth, on the one hand, to protect society from the return to it of the guilty, again to commit wrongs upon it; on the other, to save innocence from an ignominious and suffering death? Conscientious men, in case of difficulty, would rather wish to test their fidelity to their consciences and their country, by an ordeal of suffering, than to act with a doubtful precipitancy. How earnestly and faithfully jurors act, and how much they will sacrifice to the Divine sense of duty implanted in the human breast, we often see exemplified, and in the case from which has just been cited the expression of Chief Justice Tilghman, one of our former wealthiest and most public-spirited fellow-citizens, Henry Pratt, the foreman of the jury, who possessed everything that could contribute to the happiness of life, declared to the court that he "would perish before he agreed to a verdict that was against his judgment." (6 S. & R. 578.)

The late Judge James Wilson, in his course of lectures on law, with a benevolent sympathy for jurors placed under a strong obligation of attaining a unanimous result, has endeavored to state those principles of action which should or may govern them, and facilitate their conclusion. He says, "To the conviction of a crime, the undoubting and unanimous sentiment of the twelve jurors is of indispensable necessity. In civil causes, the sentiment of *a majority* of the jurors forms the verdict of the jury, in the same manner as the sentiment of a majority of the judges forms the judgment of the court." He means by this, that when the genuine sentiment of a majority of the twelve is ascertained, the minority should acquiesce, and take the opinion of the majority as the verdict of the whole, as the opinion of a majority of the judges is the decision of the court. But the cases are not parallel. The dissentient judges express their dissent, and are in nowise responsible for the judgment. But the

conscience and oath of each juror who joins in the verdict, is pledged for its truth and justice to the parties, to society, and to God. He is bound to strive for the reconcilement of truth, justice, and unanimity, or to refuse his consent to the verdict, and leave the whole matter to the trial of other jurors, or to acquit the accused, if there be a doubt of his guilt. Each juror in acquitting his conscience of the incumbent duty, must judge for himself, as he will answer to man and to God, and acting under the most solemn sense of duty, his mind must be felt in the result. He cannot acquit himself to himself or his Maker by adopting the opinion of others. He may modify and make concession as his conviction is changed, but not because seven others differ from him. Majorities upon continued effort are often convinced that they have been in error, and join the minority. The rule of unanimity imposes the necessity of an effort to convince, since a wilful majority cannot carry the verdict upon the mere strength of numbers.

The power of the Legislature to change the number and principle of unanimity in the finding of juries, was submitted to the Judges of the Supreme Judicial Court of New Hampshire, who in June, 1860, in their opinion say, at the date of the adoption of the Constitution, "Such a thing as a jury of less than twelve men, or a jury deciding by a less number than twelve voices, had never been known, or ever been the subject of discussion in any country of the common law. Upon these views we are of opinion that no body less than twelve men, though they should by law be denominated a jury, would be a jury within the meaning of the Constitution; nor would a trial by such a body, though called a trial by jury, be such within the meaning of that instrument. We think, therefore, that the Legislature have no power so to change the law in relation to juries, as to provide that petit juries may be composed of a less number than twelve, nor to provide that a number of the petit jury less than the whole number, can render a verdict in any case where the Constitution gives to the party a right to a trial by jury. They say that four States by their highest courts had decided in the same way." (23 Law Reports, 460.) These judges and those courts thus emphatically say, that an institution and a principle which the Constitutions of the Union and the States have made fundamental and sacred, for liberty and security, are not lightly to be touched by unhallowed hands. The former seem, indeed, not to have been aware of the efforts made in former bad times to make available the voice

of the majority, or to "afforce the assise," by abstracting the recusant, and adding in their place the willing tools of power; but their judgment as to all right and lawful proceedings, standing as authoritative precedents in the law, was sound, just, true, and in accord with their fealty to this inestimable institution of English and American common law.

And when such an attempt at innovation and reform was made in the British Parliament, it was opposed by Lord Lyndhurst, in language in which he contrasted the present milder and juster proceedings in trials for political offences, with those he had witnessed at the beginning of this century. "We may," said he, "be perfectly satisfied with our present, but unfortunately, I have lived in times of a different character. I have seen the time when the government was carried on upon arbitrary, and even tyrannical principles; when political prosecutions were of constant occurrence, and were conducted with extreme harshness, and punishments of great severity were inflicted for political offences. I have been myself, to a certain extent, not merely a witness, but an actor in those times. The growing prosperity of the country, producing a greater amount of content, has caused a change from the feelings that then prevailed. But, my lords, we must not so far delude ourselves as to suppose that such a state of things can never again arise. Violent political feelings may again be excited, and who can venture to say that a similar state of things may not again occur? At all events, let us not, acting under such a delusion, take any steps towards destroying the bars and fences the Constitution has given against the exercise of arbitrary power." This solemnly warning language of an English peer, of American birth, is as applicable in republican America as in monarchical England.

A verdict by majority would be dangerous from the too ready facility of attaining it. It would then be but the product of the first impression, and that often the impulse of feeling. The minority would be disregarded, and could not check undue impulsiveness, nor command a prolonged or mature deliberation. This would be the result in mere questions of property, and in the assessment of damages, where the feelings have been excited by artful and eloquent counsel, would be fearfully dangerous. But it would, in cases of a political cast, in times of high political excitement, be unendurable and fatal to liberty. It would be better that there should be no political convictions, than that they should be attained at such a cost. It is in this aspect that the institution has received its highest

encomiums, as a power resistant to tyranny. Our Judge Addison said: "Jury trials may be disused, from disuse may be forgotten, and this pillar of our liberties being removed, we may forget that we were free." (57.) Judge Blackstone explained the antiquity and praised the excellence of this trial for settling questions of property, and then proceeds to say, as to its value to liberty and security, "It will hold much stronger in criminal cases; since in times of difficulty and danger, more is to be apprehended from the violence and partiality of judges appointed by the Crown, in suits between the king and the subject, than in suits between one individual and another, to settle the metes and bounds of private property. Our law has, therefore, wisely placed this strong and twofold barrier, of a presentment and a trial by jury, between the liberties of the people and the prerogative of the Crown." "The founders of the English law have with excellent forecast contrived that no man should be called to answer to the King for any capital crime, unless upon the preparatory accusation of twelve or more of his fellow-subjects, the grand jury; and that the truth of every accusation, whether preferred in the shape of an indictment, information, or appeal, should afterwards be confirmed by the *unanimous suffrage of twelve* of his equals and neighbors, indifferently chosen and superior to all suspicion. So that the liberties of England cannot but subsist so long as this palladium remains sacred and inviolate, not only from all open attacks, which none will be so hardy as to make, but also from all secret machinations which may sap and undermine it, by introducing new and arbitrary methods of trial, by justices of the peace, commissioners of the revenue, and courts of conscience." (4 Com. 349.)

Judge Story, in his Commentaries upon the Constitution, quotes with high approval these sentiments of Blackstone upon trial by jury, and proceeds to say, "Mr. Justice Blackstone, with the warmth and pride of an Englishman living under its blessed protection, has said: 'A celebrated French writer, who concludes that because Rome, Sparta, and Carthage have lost their liberties, therefore those of England in time must perish, should have recollected that Rome, Sparta, and Carthage, at a time when their liberties were lost, were strangers to the trial by jury.'" (2 Story on Con. § 1780.) The writer thus referred to was Montesquieu, who after dwelling upon the English Constitution with an enthusiastic admiration, pauses in sadness to make this solemn reflection: "As all human things have an end, the state we are speaking of will lose its liberty; it will perish. Have not Rome, Sparta, and Carthage perished? It will perish

when the legislative power shall be more corrupted than the executive." This melancholy warning is at this moment as applicable to us, as ever it was to England; and if the trial by jury be the main bulwark for the defence of our liberties, God grant in His goodness that, in the words of our Constitution, it may forever remain inviolate; and to remain inviolate, it must be untouched in any of its principles. We have, I believe, and with the deepest humiliation I make the admission in the hope of the remedy, already in our brief history literally fulfilled that only condition which the French philosopher and patriot places before a national downfall; for already our legislatures are more corrupt than our executives, and our only hope of rescue remains in our executives, more pure than the legislative power, in the untouched integrity of our judiciaries, and in the virtue of the body of the people, who give that virtue expression more surely through the verdicts of their juries, than in the exercise of their elective franchise, or by their legislative action.

Mr. Peale presented to the notice of the Society, a box of stone implements, taken by Mr. John Evans of England, with his own hands, from the gravel-pits of St. Acheuil, near Amiens; and also, for comparison, a number of specimens from his own collection of American Indian remains. It was evidently characteristic of the European specimens, that they were of larger size, and all of them formed from the flints of the Cretaceous formation. Members present expressed their conviction that the forms were artificial.

Mr. Foulke exhibited a copy of the "Pharmacopœia Londinensis Collegarum. *Hodie viventium studiis ac Symbolis ornatior.* Londini. Typis *W. Bentley*, impensis *L. Sadler, et R. Beaumont. An.* 1668," a curious 16° (about 4 inches by 2) of 349 pages, with an *Index Remediorum*, which he presented for the Library of the Society.

Mr. Foulke stated that he had designed to offer some remarks suggested by the formulæ of this Pharmacopœia, respecting the relations of medical science and art to the general condition of science and art in England at the date of the

little volume (1668), but that he had been prevented by ill health.*

Mr. Foulke invited the attention of the Society to the impressive contrast afforded by the "Dispensatory of the

* Opposite the title is written "Ex libris Johannis Foulke." Dr. Foulke (the same gentleman who was subsequently one of the officers of this Society) probably obtained the book during his visit to London, at the date of his letters of introduction to Dr. Franklin, which are now in the Franklin MSS. collection of the Society.

On the fly-leaf is the autograph of Peter Renaudet, London, 1749. This was four years after the publication of the "Plan of a new London Pharmacopœia, proposed to the College of Physicians by their committee appointed for that purpose, Lond. 1745;" and two years after the publication of "Pharmacopœia Collegii Regalis Medicorum Londinensis. Lond. 1747" (both in the Pennsylvania Hospital Library). The Leyden Pharmacopœia followed in 1751; but Amsterdam had already published one in 1726. Fuller's P. Extemporanea, P. Bateana, and P. Domestica had appeared (the second time) in 1702, 1719, and 1723. Radcliff's Practical Dispensatory (4th ed.) appeared in 1721.

Quincy's P. Officinalis et extemporanea, or Complete English Dispensatory, appeared the third time in 1720, (eleven editions following before 1769, Claudier translating it in Paris in 1749), the same year with the second edition of Boerhaave's Materia Medica.

Salmon's London translation of Bates appeared the third time in 1706. Shipton's London edition of the P. Bateana was as early as 1688. Staphorst's Officina Chymica Londinensis appeared in 1685; and Labrosse's P. Persica in Paris in 1681. La Thériaque d'Andromachus par Charas had appeared at Paris in 1668 (the year of the Pharmacopœia presented by Mr. Foulke). Mynsicht had published a similar "Thesaurus" at Lubeck in 1662, and Hernandes at Rome in 1651.

Culpeper's "Physical Directory, or translation of the Dispensatory made by the College of Physicians in London, and by them imposed upon all the apothecaries of England, to make up their medicines by," had reached its second edition in 1650. About the same time (1653), at Rotterdam, appeared Zwelfer's P. Augustana Reformata. But we must go back to 1567 for the appearance of the Q. Sereni Samonici de Medicina Præcepta Saluberrima, at London; and to 1537 for the Villanovani Syruporum Universa Ratio, at Paris.

United States," prepared by Drs. Wood and Bache, two of the Presidents of the Society. The progress during the last two centuries, not only of Botany and Mineralogy and other sources of the Materia Medica, but of the general methods of science, is remarkably illustrated by a comparison of the two books.

Pending nomination No. 494 was read:

And the Society was adjourned.

Stated Meeting, May 15, 1863.

Present, seventeen members.

Dr. Wood, President, in the chair.

Letters accepting membership were received from William Dwight Whitney, dated New Haven, April 21st; from E. A. Washburne, dated Philadelphia, May 2d; and from James Pollock, dated Philadelphia, May 14th, 1863.

Letters to the Librarian, inclosing photographs of the writers, were read, from B. Silliman, Sr., of New Haven, Josiah Quincy, of Boston, and Gen. Swift, of Geneseo, in the State of New York.

Donations for the Library were announced from the Essex Institute, the Museum of Comparative Zoology, in Boston; the American Journal of Science and Art, Blanchard & Lea, and Dr. Parrish, of Philadelphia; Professor J. H. Alexander, of Baltimore, and the Academy of Sciences in St. Louis.

Mr. Dubois communicated the following remarks on assay-balances:

The recent receipt of two assay-beams at the Mint, procured for the use of Dr. Munson, assayer of the new branch Mint at Denver, in the Territory of Colorado, furnishes occasion for a few remarks on the progress of this delicate branch of art.

Thirty-one years ago, when Mr. Eckfeldt, the present assayer of the Mint, entered upon that office, he found that the beam on which all his operations were to turn, would not itself turn with a less weight than about the one-fiftieth part of a grain. Consequently, the nearest report of the fineness of gold was by gradations of one

thirty-second ($\frac{1}{32}$) part of a carat, which was about $1\frac{3}{10}$ thousandths, according to the present notation. The reports of the British assayers were not in those days more exact, whatever their apparatus might have been.

About three years later, Mr. Peale brought from Paris, for the use of the Mint, a beam of superior finish and much greater delicacy; in which, among other improvements, stirrups were substituted for silk cords, although there was still a cord for lifting.

Two years farther on, we had Mr. Saxton restored from England to his own country, and employed in the Mint in this branch of art, in which he had already become famous. Various decided improvements were introduced by him, in the beams made for the Mint and Branch Mints.

After this artist had been claimed by Prof. A. D. Bache, for the Bureau of Weights and Measures, and was transferred to Washington, our assay department had recourse to the manufactory of Oertling, in London. His beams, although rather complicated, and of many parts, are admirable for delicacy and beauty, and for a combination of the most desirable qualities.

The establishment of the Branch Mint, already referred to, made a fresh call for assay balances. We were about to resort to the last-named maker, when Dr. Torrey, of the United States Assay Office at New York, made a favorable mention of the manufactory of Becker & Son, at Brooklyn, from his own experience of what they could do. Any less authority would perhaps have been held insufficient, on the narrow but venerable principle of questioning whether "any good thing can come out of Nazareth." The order was consequently given by Gov. Pollock, Director of the Mint; and in a very short time two balances, with sets of weights, were made and delivered at the Mint.

It is not at all the purpose of this notice to enter into a detailed description of the parts and peculiarities of the different kinds of assay-beams. There is nothing like an actual inspection of them, to give a just idea of their merits; and persons who take a special interest, can easily have the opportunity. Suffice it to say, that this instrument compares favorably with any other, in respect to delicacy, philosophic propriety, good taste, and fine finish. In respect to simplicity and stability, two very important features, it may be said to excel.

There is one point of considerable account, in regard to this beam,—that its cost is about one-third of the London make, namely,

seventy-five dollars against two hundred and twenty-five, counting the present cost of a bill of exchange. It is difficult to understand how the Messrs. Becker can do justice to themselves, at such a price. And not only was there a saving of money, but of time also.

There is one other point worthy of a few words,—that we have here a further development of the progress of delicate workmanship in our own country. We proceed from clocks to watches, from reapers to penknives. And in regard to philosophical apparatus, if we may introduce names, it is well known that our Ritchie, at Boston, has so improved upon Ruhmkorff, of Paris, in the powerful induction-coil (the most splendid instrument of the day), as to entitle it to be called by his own name, and to be counted *American.*

It should be stated, that the balance will indicate the tenth of a thousandth of the demi-gramme, which is our normal weight in the gold assay; that is, it will turn with $\frac{1}{1300}$th part of a grain. As the beam and appendages are quite heavy, and capable of bearing twenty times the largest weight ordinarily used, it might be made much more sensitive by lightening the parts; but for working purposes, this is not desirable. Such a sensibility would serve to gratify curiosity, or to make a boast of, but would not be in keeping with the amount of deviation which is to be expected in other parts of the assay—the cupellation and parting. It would be too much like the exquisite refinement of some who report specific gravities: their apparatus carries them safely to the second decimal, but their arithmetic extends to the fourth or fifth.

Dr. Wood made a verbal communication respecting Mr. Harrison's steam boiler.

Dr. Dawson's communication on the Coal of Nova Scotia was read.

Mr. Robert Briggs of Philadelphia, communicated through the Secretary, extracts from a private professional statement of his views of the true seat of reserved power in rolling-mill machinery, and of the importance of using boilers of the largest possible *water* capacity, for accumulating and storing up the force to be expended, at intervals, with great rapidity, in the passing of the iron through the rolls.

Firstly. It is clear that in an extended mill, the waste heat of the furnaces is far in excess of what is required to supply steam for

working the iron; and that in some way the heat is, by the many boilers, available when wanted. When working out one furnace, several others are supplying heat, more or less; and yet each furnace, in a day's work, only furnishes what suffices for itself. Consequently, the question resolves itself, in this case, into,—how can you so store up heat (or power) that your three or four furnaces should be upon the same ground with three or four out of twelve or twenty?

I will consider the store-rooms of power you have. Take your fly-wheel. I assume that to be 18 feet diameter, and to weigh 32,000 pounds; then assuming the diameter of centre of rotary mass to be 16 feet, and the number of revolutions per minute, &c., as follows:

65 rev. per min. gives a vel'y per sec., with 16 ft. diam, = 54.5 ft.
50 " " " " " " " " = 41.9 ft.

Now if you consider how far a body must fall to have these velocities, ($V^2 = 64.3$ h.)

When $V = 54.5 \therefore h. = 46.2$ ft. $\times$ 32,000 lbs. = 1,478,400 ft. lbs.
$V = 41.9 \therefore h. = 27.5$ ft. $\times$ 32,000 lbs. = 880,000 " "

Difference, 598,400 " "

In other words, if the weight of the fly-wheel were permitted to fall from the heights of 46.2 and 27.5 feet, the same velocities would have been attained that 65 and 50 revolutions per minute gives, and the mechanical work given out by slowing the fly-wheel (from 65 to 50 revolutions) is 600,000 ft. lbs. (very nearly.)

Suppose this slowing to take place while rolling a long thin plate, which would be $\frac{1}{30}$th of a minute in passing the rolls. (That is taking the mean velocity assumed of $\frac{65+50}{2} = 57\frac{1}{2}$ revolutions per minute, and taking the rolls at 18 inches diameter or 4 feet $8\frac{1}{2}$ inches circumference, then the speed of the periphery of the rolls is 260 feet per minute; whence, in $\frac{1}{30}$th minute a plate $8\frac{2}{3}$ feet long would pass the rolls.) Then the fly-wheel will have developed a force represented by 600,000 $\times$ 30 ft. lbs. for one minute, or 18,000,000 lbs. in one minute, equal to $\frac{18,000,000}{33,000} = 544$ horse-power, *whilst the force lasts.*

Or, in other words, the fly-wheel will have performed the work which a 540 h. p. engine would have been needed to do. On the other hand, to restore the speed of the fly-wheel in *half a minute,* would only take at the rate of 1,200,000 ft. lbs. per minute, or the

work of a 36 h. p. engine. These calculations show that the force of the fly-wheel is only available for the exigency of part of a minute, and not as a store of force in working out a heat.

Admitting that we cannot rely upon the making of steam on the instant of rolling, as sufficient for working out the heat (even when we consider the waste-heat of your four furnaces to be employed in the formation at the time of rolling), what is the next source of force?

The following figures will demonstrate that the quantity of heated water in the boilers must supply the deficiency.

Suppose the blow-off point of the boilers to be 85 lbs., suppose the minimum working pressure of steam (to insure the proper acceleration of the fly-wheel between the passes) to be 60 lbs., then I estimate (somewhat approximately) as follows:

Pressure.	Temperature.	Volume of steam per lb. of water.	Weight of cub. ft. of water at 318°.
85	328°	4.2 cub. ft.	56.7 lbs.
60	307°	5.8 " "	

56.7 lbs. at 21° = 1191°, div. by lat. heat of water at 60 lbs.

$$\frac{1191°}{900°}$$

Giving $1\frac{32}{100}$ths lbs. of water transformed to steam (or $7\frac{1}{2}$ cub. ft. of 60 lbs. steam made) out of each cub. ft. of water in the boiler.

Suppose the governor to regulate so that 60 lbs. is the highest pressure which enters the cylinder, then each cub. ft. of steam the boilers may hold at 85 lbs. will have supplied $\frac{58}{42} = 1.38$ cub. ft. of steam to the engine. Showing that as a store of power, water contents are about five times as valuable as steam contents in the boilers.

The above indicates the ground on which is based the English practice of elephant boilers; and aside from the consideration of safety from abundance of water, and of ease of getting at the interior, to remove scale or sediment, it still further demonstrates the propriety of the objection I urged, to the abstraction of water-space by flues or tubes, in rolling-mill practice. . . . .

Secondly. To get the largest result (for combustion of coal under boilers), there is used, in tubular boilers of the best type, 3 feet of surface for each pound of coal burnt per hour.

For mill practice, with cylinder boilers, about 18 feet of surface per square foot of grate is used.

If I had but few furnaces, I should prefer to increase this to about 24 feet of surface (or even 30) per square foot of grate. This is

from 270 to 337 feet of surface for each of the grates under present consideration. . . . .

Were I limited for room, so that long cylinder boilers were impracticable, I would advise the use of French boilers in place of flue boilers. I am satisfied the French universal practice, of putting the flues outside, is superior to ours, of putting them inside, in similar cases.

. . . . . I do not wish you to assume, from all this, that I look upon a well-built two-flued boiler as seriously objectionable in a mill, only that I prefer the *same extent of surface*, with greater capacity of water, in a cylindrical form.

Mr. Chase paid a tribute to the genius and merits of M. Des Guignes, as an orientalist and etymologist, having an insight into the true relationships of the languages and histories of the east and west of Asia not sufficiently acknowledged or appreciated.

Philologists are peculiarly exposed to pert and arrogant criticism. Their favorite studies lead them into unexplored fields, and among the many hypotheses that they are obliged to hazard in their endeavors to explain the laws and phenomena of language, it is reasonable to expect that some will be overthrown by subsequent investigation. It then becomes an easy matter for sciolists to talk of seeming and fanciful resemblances, and thus throw discredit on the whole science of Etymology, while they gain a cheaply bought reputation for critical acumen. It is therefore particularly gratifying to find that many of the shrewd surmises of a true scholar, like M. de Guignes, after enduring the unstinted ridicule of his contemporaries, are confirmed by the discoveries of a later generation.

To Zoega the credit is generally given, of first forming the happy conjecture that several of the Egyptian hieroglyphs were employed merely as phonetic or alphabetic characters. But more than thirty years before he announced his views, he had been anticipated by M. de Guignes, who, in the very Memoirs that were most mercilessly criticized, not only declared his belief in the phonetic use of most of the Egyptian hieroglyphs, but also, arguing from the supposed common origin of the Chinese and Egyptian systems of writing, he surmised that the cartouches contained royal names and titles, and that the Egyptian, as well as the Chinese characters, might all be grouped under the three classes of ideographs, determinatives, and phonetics.

These three conjectures, as well as some others of minor importance, have been most completely and satisfactorily substantiated by the discoveries of the modern English, French, and German Egyptologists. In one important particular, the analogy between the two systems appears to be even closer than M. de Guignes anticipated. He considered the use of phonetics in Chinese to be more infrequent and imperfect than in Egyptian, but the conclusions of Bunsen in regard to syllabic hieroglyphs, and Sharpe's groupings of supposed hieroglyphic equivalents, render it probable that the resemblance was carried out into the minutest details,—even to the occasional employment of final characters to represent the final sounds of a word, as well as of initial characters to represent the initial sounds.

Sir Wm. Jones early announced his reasons for believing in a common origin of the Chinese, Egyptian, Shemitic, and Aryan types of civilization, and many other eminent antiquarians and ethnologists have been led by different paths to the same conclusion. My own studies have tended at nearly every step to impress me with a similar belief, and I hope at some future meeting to lay before the Society some farther results of my own investigations, as well as some confirmations of the most important hypotheses of M. de Guignes. To him will ever belong the honor, of having been one of the first to suggest that the evidences of a common origin are still traceable in the records of two of the oldest known forms of civilization, and though he may have erred in supposing that the relation of China to Egypt was filial, rather than fraternal, the error was natural, excusable, and comparatively unimportant.

Mr. Lesley, at the request of the members present at the meeting of the Board of Officers, gave a verbal narrative of the organization of the National Academy of Sciences, on the 22d–24th April, in the Chapel of the University, in the City of New York.

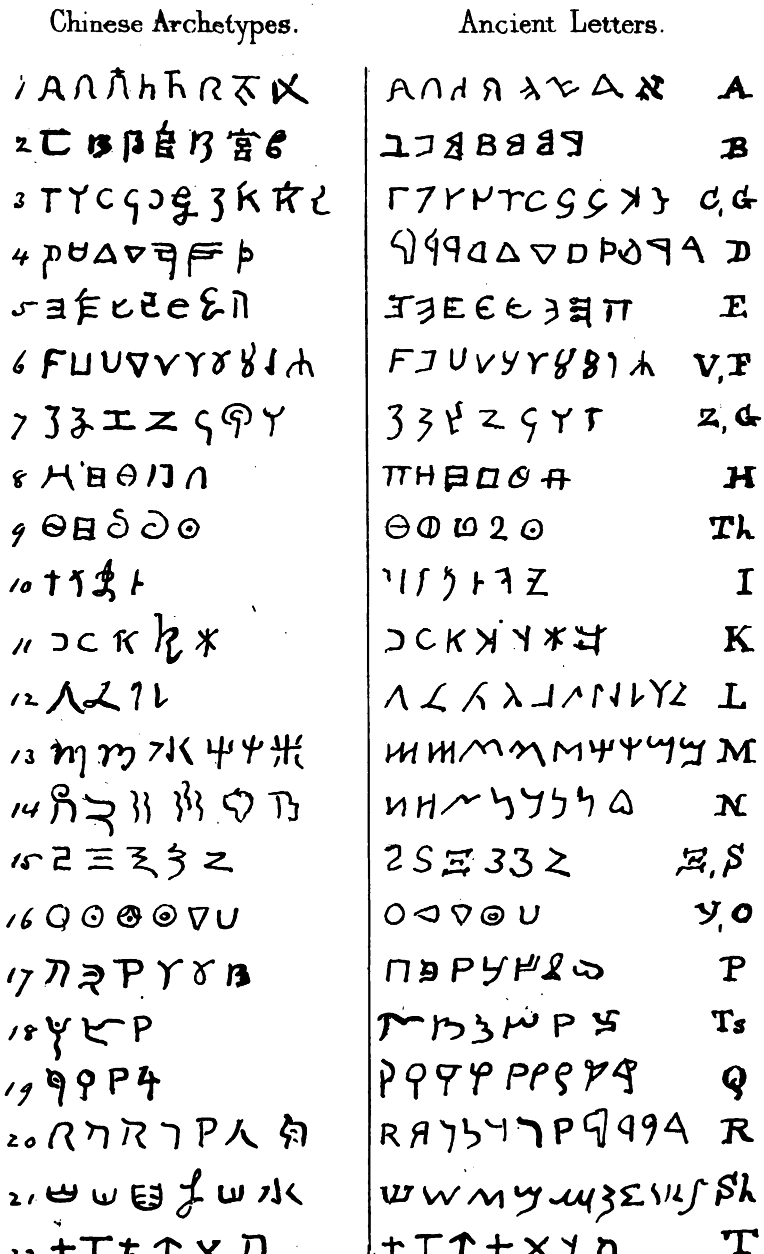
The Minutes of the last meeting of the Board of Officers and Members of Council were read.

Pending nomination No. 494, and new nominations Nos. 495 to 505, were read.

And the Society was adjourned.

By P. E. Chase.) (March, 1863.

PLATE II.



logical Societies, and Society of Arts, of London; the Bureau des Ponts et Chaussées in Paris; the San Fernando Observatory; Dr. Koch and R. Friedlander & Son, of Berlin; J. Kreittmeyer, of Munich; Professor Agassiz, of Cambridge, Massachusetts; Professor Hall, of Albany; the New Jersey Historical Society; the Franklin Institute; Messrs. Blanchard & Lea, J. F. Fisher, T. P. James, C. B. Trego, O. Reichenbach, and F. Leypoldt, of Philadelphia; Mr. J. Lacey Darlington, of Westchester; and the Wilmington Institute.

No. 69 of Volume IX of the Proceedings, just published, was laid on the table by the Secretary.

The death of C. G. C. Reinhardt, of Leyden, a member of the Society, was reported by the Secretary.

A communication intended for publication in the Transactions was presented by Mr. T. P. James, entitled, "On the Mosses of California," by Leo Lesquereux, of Columbus, Ohio, and referred to a committee, consisting of Mr. James, Mr. Durand, and Dr. Bridges, with instructions to report at their earliest convenience.

Communications "On Solar Spots," and "On Breaks in the Visible Record of History of the Variation of Species," by Dr. Reichenbach, were read by the Secretary.

SOLAR SPOTS.

BY DR. O. REICHENBACH, PHILADELPHIA.

Going over the last volumes of the "London, Edinburgh, and Dublin Magazine of Sciences," I remarked in the number for December, 1860, an article by J. Gregg, F.G.S., on solar spots, in which he mentions that Mr. Wolf has in the "Comptes Rendus," January, 1859, renounced the idea that this phenomenon might be connected with the planetary motions. He finds the hypothesis likely, but must admit that the period of spots, which he presumes to be 11.1 years, is not in accordance with that of the revolution of Jupiter, that the maximum does not at all coincide with the perihelion of that planet—*rather the contrary*—and that he has not been able to find amongst astronomical combinations a period of 11.1 years.

"Silliman's American Journal," volume 25, 1858, page 295 (prior to Mr. Wolf's opinion), contains a note, dated 13th January, 1858, in which I say, that the period of spots depends on the revolution of Jupiter, and varies principally by the influence of Saturn, as the effects of the other eight planets (I assert the existence of so many) being inferior to that of Saturn, must all fall inside *the oscillation* produced by the latter. I have farther shown that the maximum of spots corresponds to the aphelion of Jupiter.

The revolution of Jupiter is 11.86 years. I do not see how the period of spots is shown to be 11.1 years. The time since 1828, the first maximum proved by constant observation, is too short for deducing the exact period, which must be variable. Only a long observation can show it to be identical with that of Jupiter, 11.86.

Remark. As the exact period has not been ascertained, we can indulge in the hypothesis, which I, however, feel disposed to reject, that there occur seven maxima within six revolutions of Jupiter, if Saturn steadily advances, and not in the long equally delays the period. For if M the mass of Jupiter, m of Saturn, D and d their respective distances from the sun, $\frac{Md}{mD} = 6$, or the tide-creating force of Saturn being $\frac{1}{6}$ of that of Jupiter, in the sun there will be 7 maxima instead of 6, if there is only acceleration. The period of spots would be 10.17 years, and the maxima could oscillate two years before and after the aphelion passage of Jupiter, as in the case of an average period of 11.86 they can oscillate 2.4 years.

We can draw some inferences from the time before 1828.

In 1779 the attention of William Herschel was turned to the subject of "spots" by a spot visible with the naked eye. We will suppose that year one of maximum. The aphelion of Jupiter fell in 1780, or the time from 1779 to 1828, the aphelion passage of Jupiter having occurred May, 1827, occupies four revolutions and seventeen months, the maximum having occurred an equal time first before than after the aphelion passage of Jupiter. The period exceeded 11.86 years, as afterwards it has been shorter, a circumstance in favor of the average of 11.86 years. The arbitrary period mentioned by Mr. Gregg gives four periods and 4.5 years, a quite unfavorable result.

Baron Humboldt, in speaking of solar spots, gives a series of observations of different kinds:

43 a. C. n. Death of Cæsar. Dim, cool weather, one year after, political superstition. Falls, however, not two years before the aphelion of Jupiter, and coincides with that of Saturn, and can have been a maximum.

35 p. C. n. Death of the Saviour. No characteristics of sun spots; terrestrian phenomenon.

358 p. C. n. Local, terrestrian.

360. Local, terrestrian.

409. More like an eclipse.

536. One year and a half after the aphelion of Jupiter, and as long after that of Saturn ; favorable to theory.

567. Somewhat over two years before the aphelion of Jupiter, but coincident with that of Saturn; most likely a maximum, which is, however, not described by the occurrence.

626. *According to the intelligent and careful* Arabian observers, half the disc of the sun remained obscured during eight months. It is evidently the sun which is obscured. The evidence indicates a most intense maximum. In this year coincide the aphelia of Jupiter and of Saturn. This case alone seems fully to confirm the theory. The period 11.86 coincides from 1828 downward.

807. Coincides with the aphelion of Jupiter, and three years after that of Saturn; favorable to theory.

840. A little over two years before the aphelion of Jupiter, but coincident with that of Saturn. The small angular distance of the two planets increased the maximum.

934. Local, terrestrian.

1091. A few months before the aphelion of Jupiter.

1096. Could not be a maximum if 1091 was one.

1206. A local phenomenon, terrestrian.

1241. Equally local, terrestrian.

Pending nominations Nos. 494 to 505 were read.

The Committee on Mr. Lesquereux's communication reported in favor of its publication in the Transactions, which on motion was so ordered.

Bills were presented from C. Sherman, Son & Co. for printing the Catalogue, $411 75, and Proceedings, No. 69, $227 70, which, on motion of Mr. Fraley, were referred to the Finance Committee, with power to take order thereon.

On motion of Mr. Fraley, the following resolution was adopted:

"*Resolved*, That a committee, to consist of the Committee on Finance and the Committee on the Hall, be appointed to take in charge

the lease of part or the sale of the whole of the Hall of the Society, and to report to the Society on such propositions as they may receive in the premises."

And the Society was adjourned.

Stated Meeting, July 17, 1863.

Present, eight members.

Professor CRESSON, Vice-President, in the Chair.

A letter accepting membership was received from James McClune, dated Philadelphia, May 30th, 1863.

Letters acknowledging the receipt of publications were received from the Royal Academy at Göttingen, dated May 7th; the New York State Library, June 22d; the Boston Public Library, June 6th; Captain Gilliss, United States Navy, June 22d; and the Chicago Historical Society, June 23d, 1863.

Letters announcing donations for the Library were received from O. Reichenbach, dated Philadelphia, June 10th, and from the Bureau of Navigation, dated Washington, June 11th, 1863.

Donations for the Library were received from the Smithsonian Institution; the Chicago Historical Society; F. Leypoldt; Blanchard & Lea; the Academy of Natural Sciences of Philadelphia; the California Academy of Natural Sciences; the Franklin Institute; the American Antiquarian Society; American Oriental Society; New York University; Connecticut Historical Society; Dr. O. Reichenbach; Bath and West of England Society; Prince Maximilian; Royal Astronomical Society at Göttingen; Imperial Society of Naturalists at Moscow; German Geological Society; and Society of Sciences at Haarlem.

The death of George Alexander Otis, of Boston, a late

member of the Society, on the 23d of June, 1863, aged 81, was announced by Dr. Bache.

Pending nominations Nos. 494 to 505 were read.

On motion of Dr. Bache, Nos. 503 and 504 were postponed on account of the absence of the proposers. The balloting was then proceeded with.

On the report of the Finance Committee, an appropriation for paying the bill of C. Sherman, Son & Co. was passed.

The Special Committee on the lease or sale of the Hall, appointed at the last meeting, presented the following report and resolutions:

"The Special Committee appointed for the purpose of receiving and reporting any propositions that may be made for the lease of a part, or the purchase of the whole of the Hall of the Society, respectfully state:

"That after several conferences with parties representing the City authorities, the following ordinance has been passed by the Select and Common Councils of Philadelphia, and approved by the Mayor.

"An ordinance authorizing the Mayor to lease the building from the American Philosophical Society for the use of the Departments.

"SECTION 1. The Select and Common Councils of the City of Philadelphia do ordain, That the Mayor be and he is hereby directed to lease, for a term of five years, from the American Philosophical Society, the two lower stories of their building on the west side of Fifth Street, below Chestnut Street, at an annual rent of three thousand dollars, payable quarterly. Provided that the said American Philosophical Society will agree to sell the same to the City for a sum not exceeding seventy-eight thousand dollars any time within the said period of five years.

"SECTION 2. That the sum of fifteen hundred dollars is hereby appropriated to the Commissioner of City Property to pay the rent of said building for the year 1863, the warrants for which shall be drawn in conformity with existing ordinances.

"The Committee have in the negotiations agreed that in the event of the acceptance of the terms of the ordinance by the Society, the sum of four hundred dollars shall be allowed out of the first quarter's rent for the purpose of making such repairs and alterations as will fit the premises for the use of the City.

"They submit the following resolutions for the action of the Society.

"*Resolved*, That the Society agree to the terms of the ordinance of the City of Philadelphia, entitled An ordinance authorizing the Mayor to lease the building belonging to the American Philosophical Society for the use of the Departments, approved July 1, 1863, and that the President and Treasurer be authorized to execute and deliver to the City such contracts and agreements as may be necessary to carry the same into effect on the part of the Society.

"*Resolved*, That the Treasurer be and he is hereby authorized to deduct from the first quarter's rent payable by the City under said ordinance, the sum of four hundred dollars as an allowance for such repairs and alterations as the City may desire to make in the premises for the purpose of fitting them for its use.

"*Resolved*, That any repairs or alterations in the premises shall be made under the direction and with the consent of the Hall Committee."

The report was considered, and the resolutions thereto attached were unanimously adopted, and ordered to be presented to the Society at its next meeting for confirmation.

On motion, the Special Committee was continued for the purpose of superintending the preparation of the papers.

All other business having been concluded, the ballot-boxes were opened by the presiding officer, and the following named persons were declared duly elected members of the Society.

Dr. R. A. F. Penrose, of Philadelphia.

Dr. R. M. S. Jackson, U. S. A., of Cresson, Cambria Co., Pennsylvania.

Mr. Peter W. Sheafer, of Pottsville, Pa.

Mr. John Biddle, of Philadelphia.

Dr. Henry Hartshorne, of Philadelphia.

Dr. D. F. Eschricht, of Copenhagen.

Dr. C. G. N. David, of Copenhagen.

Dr. Frederick Keller, of Zurich.

Prof. A. Delesse, of Paris.

Prof. A. Daubrée, of Strasbourg.

And the Society was adjourned.

Stated Meeting, August 21, 1863.

Present, eleven members.

Professor CRESSON, Vice-President, in the Chair.

Letters accepting membership were received from Peter W. Sheafer, dated Pottsville, August 19th, and from R. W. Bunsen, dated Heidelburg, 21st May, 1863.

Letters acknowledging publications were received from Professor Haidinger, of Vienna, July 15th, and the London Geological Society, March 4th, 1863.

A letter was received from M. A. Quetelet in respect to publications sent to this and other societies for distribution.

Donations to the Library were received from the Society of Sciences at Haarlem; the Society of Antiquaries and Royal Geographical Society at London; the British American at Toronto; the Essex Institute; the Boston Natural History Society; the American Journal of Science; the New York Mercantile Library Association; the Franklin Institute; Blanchard & Lea; the Colonization Society; Frederick Leypoldt; and the Library of Congress; also, from Mr. Dubois, photographs of Messrs. Hoffman, Field, Farnum, and Faraday, of London, with autograph signatures.

Agreeably to the laws, the Society then proceeded to the consideration of the resolution for the lease and sale of the Hall, reported by the Committee on the subject at the last stated meeting. After discussion of the same, the resolutions, as reported by the Committee, were again adopted.

And the Society was adjourned.

Stated Meeting, September 18, 1863.

Present, ten members.

Judge SHARSWOOD, Vice-President, in the Chair.

Dr. Henderson, a recently elected member, was introduced to the presiding officer by Dr. Bridges, and took his seat.

A letter accepting membership was received from Dr. F. Wöhler, dated Göttingen, July 27th, 1863.

Letters announcing donations to the Library were received from the regents of the University, dated Albany, August 24th, 1863.

Letters acknowledging the receipt of publications were received from the Royal Asiatic Society, dated London, January 26th; the Corporation of Yale College, dated August 3d; and the Public Library of Boston, dated July 21st, 1863.

A letter from Ovide Brunet, Professor of Botany at the University of Laval, Canada, was read, requesting permission to copy that part of Michaux's Journal which relates to Canada. On motion, the subject of the letter was referred to Mr. Durand, with power to have a copy of the MSS. made for Professor Brunet in the Hall of the Society.

A list of the deficiencies in the set of the Society's publications, left in the Congressional Library at Washington, was received from the Librarian of Congress, and on motion the Librarian was authorized to make up the deficiencies, and forward them to Washington.

Donations for the Library were received from Dr. Wöhler, of Göttingen; M. Boucher de Perthes, of Abbeville; the Royal Astronomical and Royal Asiatic Societies, and Society of Arts, in London; the Royal Dublin Society; the New Hampshire Asylum for the Insane; the American Academy; Dr. Jarvis, of Dorchester; the Regents of the New York University; Messrs. Blanchard & Lea; the Franklin Institute; and Mr. Leypoldt, of Philadelphia.

Mr. Chase presented for the Cabinet a collection of tokens, illustrating the trade currency illicitly circulating during the war, together with a catalogue.

Collectors and others who may wish to assist in completing the collection of Token currency in the Cabinet of the American Philosophical Society, may send specimens, duplicates, or descriptions of such varieties as are not mentioned in this catalogue, to the Curators, Mr. Fr. Peale, or to the Librarian of the Society.

The star (*) denotes such varieties as are described from other collections, but are wanting in the Society's collection.

B, brass; C, copper; L, lead. Where no letter is given, the token is of copper.

The sizes are given in sixteenths of an inch. Thus, size 12 denotes that the diameter is $\frac{12}{16}$ of an inch.

The average weight of the tokens examined by Mr. William E. Dubois, Assistant Assayer, United States Mint, is 51 grains. At 32 cents per pound (the average price of copper), their intrinsic average value is $\frac{23}{100}$ of a cent.

The following descriptive list of varieties that are frequently used in "muling" is given for reference.

I. Wreath. "Not one cent."

a. "1863." Wreath unbroken.

b. Wreath without arrows. "NOT" small. "J. G. W."

c. No arrows. "NOT" large.

d. Arrows in wreath. "NOT" small.

e. Same. "**NOT**" large, and in antique letters.

f. Same. "NOT" medium.

g. "H" in wreath.

h. Eagle's head in wreath. "NOT" small.

i. Tie of wreath in a large bow.

k. Tie in a small bow. "NOT" small.

l. Same. "**NOT**" large, in antique letters.

m. Resembles *k*, but "NOT" in common letters. Wreath of a different character.

n. "Not one cent for the widows." Star in opening of wreath.

o. Two stars in wreath.

p. Unbroken wreath. "**NOT**" in antique letters. "L. Roloff."

q. Same, without "L. Roloff."

r. Unbroken wreath. Rosette in bottom of wreath.

s. Resembles *n*, but "NOT" small, in common letters.

t. "H" in wreath.

II. Wreath. "Army and Navy."

a. Wreath, with crossed swords and anchor. Star, with rays, in opening of wreath at top. Hilt of each sword touching the wreath. Flukes of anchor covering the ends of the branches that compose the wreath.

b. Same, but ends of branches not covered by flukes of anchor.

c. Resembles *a*, but "AND" in smaller letters, and nearly straight. A slight space between sword-hilt and wreath, on the left.

d. Same, with larger space between left hand sword-hilt and wreath. Left side of wreath somewhat denser.

e. Same. Swords with smaller hilts, and die not so deeply engraved. More space between the words of the inscription.

III. Wreath. "Army & Navy."

a. Wreath, with crossed swords, tied somewhat loosely.

b. Same. Swords with large hilts. Wreath straggling and coarse.

c. Wreath of two branches, with crossed stems, but no swords or tie. Letters irregular. Period after army.

d. Resembles *a*, with star in opening of wreath at top.

e. Resembles *d*, but star larger. Swords more slender, workmanship coarser, and lettering larger.

f. Left side of wreath sharp-pointed. Ribbon *close* over right sword.

g. Wreath slightly broader-pointed. Ribbon *loose* over right sword, and partly over left sword. Tie close.

h. Like *g*, with band extending from handle of right sword over the wreath. Probably from defect in die.

i. Much like *g*, but tie more open, and extending under left sword.

k. Like *i*, but wreath broader, and somewhat three-pointed. Workmanship coarser.

l. Wreath like *k*, but right end of wreath-tie bent towards the left. Workmanship fine.

m. Resembles *f* in wreath-tie, but wreath broader-pointed. Coarse.

n. Resembles *f*, but has a portion of tie coming from hilt of right sword towards the left.

o. Right end of tie extends over both swords.

p. Wreath so elaborately wrought that the general effect of the two sides is similar.

CATALOGUE.

Class I.—*Business Cards.*

*1. "J. L. Agens & Co., No. 1 Commerce St., Newark, N. J. Newspapers." *Rev.* Eagle on globe. "Union forever." Size 13.

*2. Same. *Rev.* Two stars. "Good for 1 Cent." Size 13.

3. "Atlantic Garden, 50 Bowery, New York, 1863." *Rev.* Harp and wreath. "Grand Concert Every Night. Admission Free." Size 14—.

4. "C. Bahr, cor. Cliff and Frankfort Sts., New York." *Rev.* Wreath. "Not One Cent. L. Roloff." Size 12+.

5. Same; but the word "not" in larger letters. Size 12+.

6. Same, without L. Roloff's name. Size 12+.

7. Same obv. *Rev.* "Erinnerung an 1863." Size 12+.

8. Same obv. *Rev.* Eagle on shield, with motto "E Pluribus Unum. United States of America, 1863." Size 12+.

9. "J. C. Bailey, City Hotel, Jersey City." Wreath and two stars. *Rev.* "Thos. Bennett, 213 Fulton St., N. Y." Wreath. Size 16.

10. "H. J. Bang, Restaurant, 231 Broadway." *Rev.* "Importer of Rhine Wines." Bunch of grapes. "Glaubrecht." Size 14.

*11. "Barker & Illsley, Hardware, Nails & Stoves, 277 State St. Chicago." *Rev.* Wreath. "Business Card." Size 12½.

12. "M. F. Beirn, Magnolia Hotel, 100 So. 8th St., and 416 Library St., Philadelphia." *Rev.* Head with liberty cap, and thirteen stars. Size 12.

*13. "Benjamin & Herrick, Fruit Dealers, Albany, N. Y." *Rev.* "Redeemed at 427 Broadway, 1863." Corner of figure seven nearly touching the D in "Redeemed." Size 12+.

14. Same. Corner of figure seven nearly touching the A in "At." Size 12+.

15. "V. Benner & Ch. Bendinger, 1863." Two stars, head with feather crown; "L. Ruloff." *Rev.* Bottle and wreath. "Importers of Wines & Liquors, No. 1. Ave. A." Size 15+.

16. "J. L. Bode, Birdstuffer, 1863." Stag's head. *Rev.* "Bohemian Fancy Glass Work, 16 N. William St., N. Y." Size 15+.

*17. "Oliver Boutwell, Miller, Troy, N. Y." Two stars. *Rev.* "Redeemed in bills at my office." Four stars. Size 12+.

18. Same. *Rev.* "Redeemed at my office, 1863." Extremity of upper scroll over C in "office." Size 12.

*19. Resembles 17, but has no stars on the obverse Size 12+.

*20. Resembles 18, but point of scroll nearly touches the I in "office." Size 12+.

*21. Resembles 18, but has no stars on obverse. Size 12+.

*22. Resembles 18, but points of scroll are outside of M and R in "Miller," instead of underneath those letters. Size 12+.

*23. "Jas. Brennan, 37 Nassau St., Foreign & U. S. Postage Stamps." *Rev.* Eagle. "Union for Ever." Size 12½.

24. Same. *Rev.* Head of McClellan. "General G. B. McClellan." Size 12+.

*25. "T. Brimelow, Druggist, 432 Third Avenue, N. Y. 1, 1863." Mortar and wreath. *Rev.* Head of Washington, and six and seven stars. "Geo. Washington, President." Size 15.

*26. "T. Brimelow, (2) 432 3d Ave., N. Y." *Rev.* as in 25. Size 15.

*27. Like 25 on obv. *Rev.* Head of Washington and eight stars. "Geo. Washington, President." Size 15.

*28. "Broas, Pie Baker. One Country. 131 41st St., N. Y." One star, with "H" underneath. *Rev.* same as obv. C. Size 12½.

29. Like 28, but in brass. Size 12½.

30. Same obv. *Rev.* Head with feather crown. "United we Stand. 1863." C. Size 12+.

31. Same in brass. Size 12+.

32. Same in lead. Star without "H." Size 12+.

33. "Broas Brothers, Pie Bakers. Our Country." Wreath and two stars. *Rev.* Head of Washington and flags. "United we Stand. 1863." C. Size 12+.

34. Same in brass. Size 12+.

*35. "Broas Bros. New York. Army and Navy." Wreath and two stars. *Rev.* as in 30. Size 12½.

36. "M. S. Brown. 1863." Letters of uniform size. Wreath and shield. Tie of wreath close over arrows. *Rev.* "Eureka. 2 Warren St., New York." Size 13.

37. Same, but initial letters M. S. B. larger than ROWN. Size 13.

*38. Like 36, but tie loose over arrows. Size 13.

39. "Cafe Autenrieth, 85 Chatham St., N. Y. 1863." The

words "Chatham St." in a curved line. *Rev.* Head with feather crown. Size 12.

40. Same. *Rev.* Wreath. "Not One Cent." The word "Not" in medium-sized letters. Maker's name, "L. Roloff," in small letters. Size 12.

*41. Same, but word "NOT" in small letters. Size 12.

42. Same, without maker's name. "NOT" in antique condensed letters. Size 12.

43. Like 40, except "NOT," which is as in 42. Size 12.

44. Same as 40, but "Chatham St." in a straight line, and two stars added on *obv.* Size 12.

45. "Carland's, 95 Bowery, cor. of Hester St., N. Y." *Rev.* "Fine Ale drawn from Wood." Two stars. Size 12+.

*46. "Charnley, No. 11 Orange St., Providence, R. I." Anchor on shield, and thirteen stars. *Rev.* Wreath. C. "Union. 1863." Size 12.

*47. "R. H. Countiss, Grocer & Tea Dealer, Clark St., cor. Van Buren, Chicago, Ill." *Rev.* Wreath. "Business Card." Size 12½.

48. "Coutts & Bro., Dry Goods & Groceries, P. Amboy, N. J." *Rev.* "Good for 1 Cent." Two stars. Size 13.

*49. "Tom Cullen, Liquors, 609 Grand St., N. Y." *Rev.* Wreath. "Not One Cent." "NOT" in small letters. Size 12.

50. Same. "NOT" as in 42. Size 12.

51. "J. J. Diehl, Undertaker, 133 Essex St., New York." Coffin, wreath, and two stars. *Rev.* Head with feather crown, and thirteen stars. "1863." Size 15+.

52. "C. Doscher, 241 Washington St., N. Y. Not One Cent. H." Wreath, and two stars. *Rev.* Head with feather crown, and six and seven stars. "1863." Upper star over second feather. Size 12+.

53. Same, upper star over third feather. Size 12+.

54. "C. Doscher, 241 Washn St, N. Y., 1863." Head of Washington. *Rev.* Wreath. "Not One Cent. H." Size 12+.

*55. "John Engel, Merchant Tailor, 52 First St., Elizabethpt, N. J." *Rev.* Sun-rays; two small heads. "I–O–U 1 Cent. Pure Copper." Size 13.

56. "Felix בשר Dining Saloon, 256 Broadway, New York." Two stars. *Rev.* Head with feather crown, and thirteen stars. "1863." Size 12.

*57. "Flagg & MacDonald, Boots & Shoes, 181 Lake St., Chicago, Ill." *Rev.* Wreath. "Business Card." Size 12½.

*58. "R. Flanigan's Punch. 112, 156 North 6th St." Punch-

bowl and two stars. *Rev.* "Pure copper preferable to paper. Philada." Size 13.

59. "Fox's Casino." One star. *Rev.* "Chesnut St., 620, Phila." Size 12½.

*60. "Freedman, Goodkind & Co., Dry Goods, 135 Lake St., Chicago, Ill." *Rev.* Wreath. "Business Card."

61. "Fr. Freise, Undertaker, 12 Av. A, New York, 1863." Coffin and wreath. *Rev.* "Fr. Freise, Leichenbesorger, 12 Ave. A, New York." Two stars. Head with feather crown. Size 15+.

62. "J. F. Gardner, 55 Henry St., N. Y." Two stars. *Rev.* Head with feather crown, and thirteen stars. "1863." Size 12.

63. "A. Gavron, 213 Bowery & 102 Pitt St., N. Y. Sausages." *Rev.* "Good for 1 Cent." Two stars. Size 13.

*64. Same, with ornaments added at each side of each star. Size 13.

65. Same *obv.* *Rev.* "I–O–U 1 Cent." "Pure Copper." Sun with rays; two small heads. Size 12+.

66. "Charles Gentsch. 1863." Head with feather crown; four stars. *Rev.* "Café Restaurant du Commerce, No. 426 Broadway, N. Y." Size 12.

67. "H. D. Gerdts, Broker & Coin Dealer, 240 Greenwich St., N. Y." *Rev.* Man with bundle, and motto, "Go it buttons." "Money makes the mare go. 1863." Size 12.

68. "G. Graham, Liquors, cor. Henry & Montgomery Sts., cor. Bleecker & Tenth Sts." *Rev.* Wreath. "NOT One Cent." Size 13.

69. "J. A. C. Grube. Segars and Tobacco, 7 Bowery 7, New York." *Rev.* Wreath. "NOT One Cent." Size 12.

*70. Same. *Rev.* "Erinnerung an 1863." Size 12.

71. "John P. Gruber, New York." Pair of scales. *Rev.* "Apoth. Weight One Dram. 1863." Eagle and two olive branches. Size 13.

72. "John P. Gruber, 178 Chatham Sq." Pair of scales. *Rev.* "1863." Head with feather crown, thirteen stars. Size 12.

*73. "M. Hartzel, Grocer & Commission Merct., N. W. cor. 3d & Elm Sts., Cincinnati." *Rev.* "1862." Head with feather crown, thirteen stars. Size 12.

74. "William Hastings. 1863." Head with feather crown. *Rev.* Wreath. "Imported Liquors." L. Size 12+.

75. "C. J. Hauck, 108 Leonard St., Brooklyn, E. D., N. Y." *Rev.* Wreath. "NOT One Cent. L. Roloff." Size 12.

76. "Chr. F. Hetzel, Roofer, New York." ***Rev.*** "1863. B. & K." Press. Size 13.

77. "Hussey's Special Message Post, 50 William St., New York." One star. *Rev.* Man on horseback. "Time is Money. 1863. Exigency." B. Size 12+.

78. Same, in copper. Size 12+.

79. "Hussey's Special Message Post, 50 Wm. St., N. York." Locomotive and two stars. *Rev.* Man on horseback. "Time is Money. 1863. Expediency." B. Size 12+.

80. "George Hyenlein, 23 Chrystie St., N. Y." One star. *Rev.* Wreath. "NOT One Cent. L. Roloff." The word "NOT" in small letters. Size 12.

81. Same, without L. Roloff's name on *rev.* "**NOT**" in antique letters. Size 12.

82. Same *obv.* *Rev.* Head of Washington in star, with wreath. Size 12.

83. Same *obv.* *Rev.* Head with feather crown. Thirteen stars. "1863" in small figures. Size 12+.

84. Same, but "1863" larger. Size 12+.

*85. "T. Ivory, cor. Fulton and Orange Sts., Brooklyn. Billiard Saloon." *Rev.* "I–O–U 1 Cent. Pure Copper." Two small heads, solar rays. Size 13.

*86. "John Joergens, North Second St., Brooklyn, E. D., L. I." One star. *Rev.* Wreath. "NOT One Cent. L. Roloff." Size 12.

87. "W. Johnston, Die Sinker, 154 Everett St., Cin., O." One star. *Rev.* Head with feather crown. Thirteen stars. "1863." Size 12+.

88. "W. Johnston, Die Sinker, Cin., O." One star. *Rev.* Shield. Thirteen stars. "Union." Size 12+.

89. "Christoph Karl, 42 Avenue A, New York." Harp, star, and wreath. *Rev.* Columbia seated. "1863." Size 15.

90. "R. T. Kelly, 1319 Third Av., New York. 1863." Hat. "E. S." *Rev.* "Constitution and the Union." Shield, wreath, and one star. "E. S." C. Size 12+.

*91. Same in brass.

*92. "A. Killeen, No. 1 and 16 Ferry St., Greenpoint." *Rev.* "Good for 1 cent." Two stars. Size 12½.

93. "Knoop's Segars and Tobacco, 131 Bowery, New York. 1863." Two stars. *Rev.* Wreath. "Not One Cent. L. Roloff." Size 12+.

94. Same. "NOT" in smaller letters. Size 12+.

95. Same, without L. Ruloff's name. "**NOT**" in antique letters. Size 12+.

96. Same *obv.* *Rev.* "Erinnerung an 1863." Size 12+.

97. "Charles Kolb, Restaurant, 102 Market St." *Rev.* Head with feather crown. Thirteen stars. "1863." Size 13.

98. "F. & L. Ladner, North Military Hall, 532 N. Third St." Harp, two stars. *Rev.* Two females supporting a shield. Arm holding scales. Plough, ship, thirteen stars. "1863. Philada." Size 13+.

99. "H. M. Lane, Lamps, Kerosene Oil, &c., 18 Spring St., N. Y." *Rev.* Wreath, open at top, tied at bottom. "Not One Cent." Size 12+.

100. Same, but wreath closed, and without tie. "NOT" small. Size 12+.

101. Same as 99, with addition of maker's name. "L. Ruloff." "**NOT**" antique. Size 12+.

102. Same *obv.* *Rev.* "Erinnerung an 1863." Size 12+.

103. Same. *Rev.* Wreath, with head of Washington in star. Size 12+.

104. Same. *Rev.* Shield and eagle, with motto, "E Pluribus Unum. United States of America. 1863." Size 12+.

105. Same. *Rev.* Head with feather crown. Thirteen stars. "1863." Size 12+.

*106. "Charles Lang. 1863." Head and six stars. *Rev.* "Die Sinker and Gen'l Engraver, Worcester, Mass." Three stars. B. Size 14.

*107. Same, in copper. Size 14.

*108. "S. Lasurs, Dealer in Rags and Metals, 26 15 St., Cin., O." One star. *Rev.* Head with feather crown, thirteen stars. "1863." Size 12+.

109. Same. *Rev.* Shield and thirteen stars. "Union." Size 12+.

110. "H. Lasaress, Dealer in Rags and Metals, 26 15th St., Cin., O." *Rev.* as in 105. Size 12+.

*111. "F. A. Leavitt, Family Groceries, Crockery, &c., Wholesale and Retail, 355 State St., Chicago, Ill." *Rev.* Wreath. "Business Card." Size 12½.

112. "Gustavus Lindenmueller, New-York." Wreath and beer mug. *Rev.* Bearded head and thirteen six-pointed stars. "1863." Size 16.

113. Same, but inscription on *obv.* nearer the wreath, and "New York," in closer letters. Size 16.

114. "Gustavus Lindenmueller, New York. Odeon." Wreath. *Rev.* as in 112, except the stars, which are five-pointed. Size 16.

115. "Charles A. Lührs, 77 Pike Slip, cor. of Water St., New York." *Rev.* Goblet and wreath. "Pike Slip Shades. 1863." Size 13.

*116. "C. Magnus' National Printing Establishment, New York." Shield and eagle, with motto, "E Pluribus Unum." *Rev.* "100 entitle to a $2.00 view of New York City." Head of Washington, and three stars. Size 12.

117. "J. Mahnken, 19 and 22 West St., N. Y. Liquors and Segars." *Rev.* Head of McClellan. "General G. B. McClellan." Size 12½.

118. Same. *Rev.* "Good for 1 cent." Two stars. Size 13.

119. Same. *Rev.* Head with liberty cap. "For Public Accommodation. 1863." Size 12½.

120. Same. *Rev.* Eagle. "Union forever." Size 13. .

121. Same. *Rev.* "I–O–U 1 Cent. Pure Copper." Sun's rays, two small heads. Size 13.

122. "B. Maloney, Proprietor." Head with feather crown, two stars. *Rev.* "National, 499 Third Avenue. 1863." Four stars. Size 12.

123. "Jos. H. Merriam, Medalist, Die Sinker and Letter Cutter. Established 1850. No. 18 Brattle Square, Boston." *Rev.* Two stars. Dog's head, with "Merriam," on collar. "Good for a scent. 1863." Size 12.

*124. Same. *Rev.* Wreath. "Jos. H. Merriam, Boston. 1863. Not one cent." Size 12.

125. "Edward Miehling's Meat Market, 85 Ave. B., N. Y." *Rev.* Head with feather crown. Thirteen stars. "1863." Size 15+.

126. "Use Miller's 50 cents N. Y. Hair Dye." *Rev.* "Use Miller's 25 cents Hair Invigorator." Size 12.

127. "G. M. Mittnacht's Eagle Safe." Safe. *Rev.* "23 Spring St., New York." Meat-cutter and block, four stars. Size 12+.

128. Same, with three stars before the word "Eagle." Size 12+.

129. "Monk's Metal Signs." Wreath of stars. *Rev.* Head of Liberty and thirteen stars. "1863." B. Size 12.

*130. Same in copper. Size 12.

131. Same *obv.* *Rev.* Head of Washington in wreath, and six stars. "399 B. Way, N. Y., 1863." Size 12.

132. "Henry C. Montz. Orpheus Hall." Head, ring, two stars. *Rev.* "A token of the War for the Union. 1863." Size 16.

*133. "New York & Albany People's Line of Steamboats." Five stars. *Rev.* "Time Table. Leave N. Y. 6 P.M. Leave Albany 7½ P.M." Size 12.

134. "G. Parsons, 24 John St., N. Y., Fire Works." Two stars. *Rev.* Head with feather crown and thirteen stars. "1863." Size 12+.

135. "Ches Pfaff. Restaurant, 647 Broadway, N. Y." *Rev.* Full-length figure of a monk. Size 12.

136. "Pulmonales for Coughs and Colds." Six stars. *Rev.* Wreath and star. "Union & Liberty." Size 12+.

137. "John Quinn, Grocer, cor. 26 St., Lexington Av." Small eagle. *Rev.* "I–O–U 1 Cent. Pure copper." Sun's rays, two small heads. Size 13.

138. "I. Rees, 401 Central Av., Cincinnati, O." Six stars. *Rev.* Eagle flying and twelve stars. "1863." Size 12+.

139. "Robinson & Ballou, Grocers, Troy, N. Y." Scrollwork and two stars. *Rev.* "Redeemed at our store. 1863." Scroll-work. Brass. Size 12.

140. "F. P. Rogers, 937 Sth. 10th St., Philada., Pa., 1863." Milk can. *Rev.* "Manufacturer of Milk Cans, Dairy Fixtures, Roofing and Gutter Tin." Size 12.

141. "Frederick Rollwagen, Jr. 1863." Head with feather crown. *Rev.* "587 Third Avenue, and 20 & 21 Centre Market, N. Y." Size 12.

*142. "St. Charles Billiard Rooms, 584 & 586 8th Av., N. Y." One star. *Rev.* Close wreath. "Not one cent." Size 12+.

*143. Same, with addition of maker's name. "L. Roloff." Size 12+.

*144. Same *obv.* *Rev.* Head with feather crown. Size 12+.

145. "Edw. Schaaf, 14 & 16 Division St." *Rev.* Anchor on shield, two stars. "New York, 1863." Size 12.

146. Same. *Rev.* Thirteen stars. "New York, 1863." Size 12.

147. Resembles 145, with ten stars on *obv.* Size 12.

148. "John Schuh's Saloon, 88 First Ave., N. Y." Two stars. *Rev.* Head with feather crown, thirteen stars. "1863." Size 15+.

149. "Edwd. Schulze's Restaurant, 24 William Street." Three

stars. *Rev.* Stag's head. "26 & 28 Exchange Place, N. Y., 1863." Size 13½.

150. "Ph. J. Seiter's Market." Cow's head and four stars. *Rev.* "Redeemed at my market, 102 Third Ave., N. Y." B. Size 12+.

*151. "Smick's." Wreath. *Rev.* "Neptune House, Atlantic City, 1863." Thirteen stars. Size 12½.

152. "I. Sommers, Jones Wood Hotel, N. Y." *Rev.* Tree, thirteen stars. "Horter, 1863." Size 14.

153. "Staudinger's, 116 Broadway, N. Y." Two stars. *Rev.* Shield, with motto, "E Pluribus Unum, 1863." Size 15+.

154. Same, but smaller. Size 12+.

155. "S. Steinfeld, Sole Agent for the U. S." French Imperial coat of arms. *Rev.* "Principal depot 1863 of the French Cognac Bitters, 70 Nassau St., N. Y." Size 15+.

156. "Steppacher, Agt., Orleans House, 531 Chestnut St., Phila." *Rev.* Two flags, rising sun, and thirteen stars. "1863." Size 13.

157. "Story & Southworth, Grocers, 53 Vesey St., N. Y." Two stars. *Rev.* Head with feather crown, thirteen stars. "1863." Size 12+.

158. Same. *Rev.* Eagle seated on shield, with motto, "E Pluribus Unum, United States of America, 1863." Size 12+.

*159. Same. *Rev.* Wreath. "Not one cent. L. Roloff." Size 12+.

*160. "Terhune Brothers, 71 & 73 Newark Av., Jersey City, N. J., Hardware." *Rev.* Eagle on globe. "United States copper." Size 12½.

161. "Wm. Thierbach, 142 Elm St., 1863." Head with feather crown. *Rev.* Wreath and one star. "Grocer." L. Size 12+.

162. Same; but "GRO CER," in two lines. L. Size 12+.

163. "B. W. Titus, 20 E. State St., Trenton, N. J." Scrollwork. *Rev.* "Dry Goods, Oil Cloths, Carpets, &c." Scrollwork. B. Size 12+.

*164. "C. Tollner & Hammacher, Hardware, 209 Bowery, New York." Two stars. *Rev.* Wreath. "Not one cent. L. Roloff." Size 12+.

165. Same. "NOT" in antique letters. Size 12+.

*166. "Buy Meat of Van Wunder in Market." *Rev.* Head with feather crown, thirteen stars. "1863." Size 12.

167. "Peter Warmkessel, 8 Duane St, New York." *Rev.*

"Established A. D. 1850." Store with sign "Warmkessel." Size 13.

168. "Wm. F. Warner, No. 1 Catharine Market." Small eagle and small head. *Rev.* Head with liberty cap. "For Public Accommodation. 1863." Size 12½.

169. Same. *Rev.* "I-O-U 1 cent. Pure copper." Sun's rays, two small heads. Size 12½.

170. "Washington Market Exchange." Turkey-buzzard with spread tail: two stars. *Rev.* "Live and Let Live. 1863." Bunch of vegetables. Size 14.

171. "Washington Restaurant, No. 1 Broadway, N. Y." *Rev.* as in 169. Size 12½.

*172. "John Watson, 381 Bowery, N. Y. 1863." Head with feather crown. *Rev.* Wreath: two stars. "Union Tea Store." Size 12+.

173. "Thomas White. 1863." Head with feather crown. *Rev.* "Butcher, No. 13 and 14, Abattoir Place, West 39th St. N. Y." Two stars. Size 12.

174. "White, Hatter, 216 Broadway." *Rev.* Head with feather crown, nine stars. "1863." Size 12.

175. "J. Wightman, 188 Washington St., Newark, N. J." *Rev.* Head with feather crown, thirteen stars. "1863." Size 12+.

176. "Daniel Williams, Grocer, corner Court & Warren Sts, Brooklyn." *Rev.* "Good for 1 cent." Two stars. Size 12½.

*177. Same, with ornaments at each side of each star. Size 12½.

*178. "Wilson's 1 Medal, H." Wreath. *Rev.* Head with liberty cap, thirteen stars. "1863." B. Size 12+.

179. Same, in copper. Size 12+.

180. Same *obv.* *Rev.* Head of Washington; 6 + 6 stars. "1863." Size 12+.

181. "D. L. Wing & Co., 318 Broadway, Albany, N. Y." Scrollwork; two large and three small stars. *Rev.* Wreath. "Union Flour." Size 12+.

182. "Wright, Cincinnati, 1863." Ten stars. *Rev.* Eagle flying, twelve stars. "1863." Size 12+.

*183. "H. B. Xelar, Wine and Beer Saloon." Four stars. *Rev.* Thick wreath, with two crossed large-hilted swords. "Army & Navy." Size 12.

*184. Same, but wreath formed of two branches with crossed stems, but no sword or ties. Size 12.

*185. Same, but wreath somewhat as in 183, with star in opening at top. Size 12.

186. Same *obv.* *Rev.* Wreath, open at top and tied at bottom. "1863." Size 12.

CLASS II.—*Portraits.*

187. Head of Washington, 6+7 stars. "1863." *Rev.* Shield, banners, liberty cap and pole, wreath and thirteen stars. Size 12.

188. Head of Washington, 6+6 stars. "1863." *Rev.* "New York." Wreath and stars. Size 12+.

*189. Head of Washington, two crossed flags and thirteen stars. "1863." *Rev.* "Exchange." Wreath. B. Size 12+.

190. Same, in copper. Size 12+.

191. Same *obv.*, but stars crowded between the banners. *Rev.* Wreath and clasped hands. "Peace forever." Size 12+.

192. Head of Washington, two olive branches crossed, and thirteen stars. "1863." *Rev.* Wreath and star, with shield in centre. Size 12+.

*193. Head of Washington. "General Washington." *Rev.* Eagle with arrows. "In unitate fortitudo. Spielmünze." Size 12.

194. Small head of Washington on star, inclosed in wreath. *Rev.* Wreath open at top, tied at bottom. "Not one cent." Var. k. Size 12½.

*195. Head of Washington. "George Washington." *Rev.* "Avoid the extremes of party spirit." Wreath open at top. Size 12.

196. Head of Franklin. "Benjamin Franklin." *Rev.* "Penny saved is a penny earned." Wreath and star. Size 12½.

197. Head of Jackson; one star. "The Union must and shall be preserved." *Rev.* Wreath. "This medal, price one cent." Size 12+.

198. Same. *Rev.* Rattlesnake and stars. "Beware. 1863." Size 12.

199. Head of Jackson, two stars. "For our Country. A Common Cause." *Rev.* "Now and Forever." Size 12.

200. Head of McClellan. "Geo. B. McClellan. 1863." *Rev.* Wreath. "Army and Navy." Var. p. Size 12+.

201. Head of McClellan, with wreath and thirteen stars. "Little Mack. 1863." *Rev.* Two stars. "McClellan medal for one cent." Size 12½.

202. Head of McClellan. "General G. B. McClellan." *Rev.* Eagle. "United States Copper." Size 12½.

203. Head of McClellan. "This Medal of G. B. McClellan Price." *Rev.* "One Cent." Wreath and shield. Size 12+.

204. Like 202 on *obv.* *Rev.* Man with cane. "Knickerbocker Currency." Size 13.

CLASS III.—*Equestrian Statues, Fancy Heads, and Human Figures.*

a. Equestrian Statues.

205. "1863. First in War, First in Peace." The date extends too far to the left to be symmetrical. *Rev.* Wreath, shield, and flags. "Union forever." Size 12+.

206. Same. Date more symmetrical. Figure of man somewhat larger. Size 12+.

b. Head with liberty cap.

207. "For Public Accommodation. 1863." *Rev.* "Horrors of War, Blessings of Peace. 1863." Female head. Two crossed cornucopias. Size 12+.

208. Same. *Rev.* Eagle on globe. "United States Copper." Size 12+.

209. Same. *Rev.* Man with cane. "Knickerbocker Currency." Size 12+.

210. Thirteen stars. "1863." *Rev.* Wreath. "Millions for Defence, Not one cent for Tribute." Size 12½.

211. Same. *Rev.* Wreath with shield at bottom. "I-O-U 1 cent." B. Size 12+.

212. Same, in copper. Size 12+.

213. Same. *Rev.* Wreath, two stars and shield. "God Protect the Union." The stars on *obv.* are arranged 6+7. Size 12+.

214. Same. *Rev.* Wreath. "Union forever." Size 12+.

215. Same. *Rev.* Wreath and clasped hands. "Peace forever." Size 12.

*216. Same. *Rev.* Wreath and star. "New York." Size 12.

217. Same. *Rev.* Wreath. "Not one cent." Size 12.

218. Same. *Rev.* "In remembrance of the war of 1861, '62, '63." Size 12.

219. Same. *Rev.* Flags, cannons, drum, liberty cap and pole. Size 12+.

220. Same. *Rev.* Wreath. "Not one cent." Size 12½.

221–231. Same. *Rev.* Wreath. "Army and Navy." Variety *d* in C and B, and varieties *f* to *o*, in C. Size 12.

232. Same. *Rev.* Wreath. "Not one cent." Var. *r*. Size 12.

c. Head with feather crown.

233. No inscription on *obv.* *Rev.* Wreath. "Not one cent." 1863. Var. *a.* Size 12.

234. "Millions for contractors, 1863." *Rev.* "Not one cent for the widows." Var. *n.* Wreath and star. Size 12+.

235. "Union and Liberty. 1863." Two stars. *Rev.* "One Country." Wreath. Size 12+.

236. Stars in raised ring. "1863." *Rev.* Wreath. "Not one cent." Var. *e.* Size 12+.

237. Thirteen stars. "1863." *Rev.* "City of New York. 1863. I. O. U. One Cent." Two stars. Size 15+.

238. Thirteen stars. "1863." "Liberty," on fillet. *Rev.* Wreath, flags, cannons, drum, liberty cap and pole. Size 12.

239. Same as preceding, except dots on fillet, instead of "Liberty." Size 12.

240–245. Thirteen stars. "1863." *Rev.* Wreath. "Not one cent." Varieties *b, c, d, e, f, l.* Size 12.

246. Nine stars. "1863." *Rev.* "Army & Navy." Var. *c.* Size 12.

247. 6 + 7 stars. "1863." *Rev.* "McClellan medal for one cent." Two stars. Size 12+.

248–254. Same. *Rev.* Wreath and star. "Army and Navy." Varieties *b, d, g, h, i, k, n.* Size 12.

255–257. Same. *Rev.* Wreath. "Not one Cent." Varieties *h, i, m.* Size 12.

d. Fancy Heads.

258. Head and thirteen stars. "L. Leichtweis. 1863." *Rev.* Wreath. "Millions for defence, Not one cent for tribute." Size 12½.

259. Head, two arrow-points. "Liberty and no Slavery. 1863." *Rev.* Wreath, shield, flags, thirteen stars, liberty cap and pole. Size 12.

e. Human Figures.

260. Man with cane. "Knickerbocker Currency." *Rev.* As in No. 169. Size 12+.

261, 262. Same. *Rev.* "Good for 1 cent." Two stars. B. & C. Size 13.

*263. Same. *Rev.* Eagle. "Union forever." Size 12+.

264. Same. *Rev.* Man with bundle. "Go it buttons. Money makes the mare go. 1863." Size 12+.

*265. Obverse like *rev.* of preceding. *Rev.* Eagle on globe. "United States copper." Size 12½.

266. Man with sword, flag, Monitor, and ornamental border. *Rev.* Wreath open at top; two swords. "Army & Navy." Size 12.

CLASS IV.—*Animals.*

*267. Eagle. "United States copper." *Rev.* "Good for 1 cent." Two stars. Size 12+.

*268. Same. *Rev.* "I–O–U 1 Cent. Pure copper." Size 12+.

269. Eagle on globe. "Union forever." *Rev.* Female head; two horns of plenty. "Horrors of War, Blessings of Peace. 1863." Size 12+.

270. Same. *Rev.* Shield and two stars. "Tradesmen's currency. Good for one cent." Size 12½.

271, 272. Eagle standing on shield, with motto, "E Pluribus Unum. United States of America. 1863." *Rev.* Wreath. "Not one cent." Var. *l*, *q*. Size 12+.

273. Eagle on shield, flags, and wreath. "Union" on shield. *Rev.* Wreath, flags, cannons, drum, liberty cap and pole. Size 12.

274. Bees and hive. "Industry, C. D. H., 1863." *Rev.* Wreath. "Not one cent." Var. *r*. Size 12+.

CLASS V.—*Flags.*

275. Wreath, U. S. flag, and thirteen stars. *Rev.* Rays. "No North, No East, No South, No West. One Country." Size 12.

276. U. S. flag, thirteen stars, and liberty cap. "The Flag of our Union. 1863." *Rev.* "If any body attempts to tear it down, shoot him on the spot. Dix." Five stars, two rings within the border. B. Size 12+.

*277. Same, with only one central ring, and one star. "1863," omitted on *obv.* B. Size 12+.

278. Same, in copper. Size 12+.

279. Same *obv.* "1863." *Rev.* Wreath. "Army and Navy." Var. *c*. Size 12+.

280. Four flags grouped, rays, and thirteen stars. "Union. 1863." *Rev.* Wreath, star, and rays. Size 12.

281. Wreath, flags, cannons, drum, liberty cap and pole. *Rev.* Wreath and shield. "Our Country." Size 12.

Class VI.—*Miscellaneous Devices.*

282. Monitor. Thirteen stars. "C. D. H. 1863." *Rev.* Wreath. "Our Navy." Size 12.

283. Monitor. "Our Little Monitor." Lower line of water nearly straight. *Rev.* Wreath, cannons, three cannon-balls, and anchor. "1863." Size 12+.

284. Same, but water-line curving. Wreath on *rev.* not so finely wrought. No cannon-balls. Size 12+.

285. Ship and six stars. "Trade & Commerce." *Rev.* "Coppers 20 per ct. Premium." Size 14.

286. U. S. Capitol, and eight stars. "United States. 1863." *Rev.* Wreath. "Army & Navy." Var. *a*. Size 12.

287. Thistle. "United we stand, divided we fall." Two stars. *Rev.* "Drugs, Dry Goods, Groceries, Hardware & Notions." Four stars and six crosses. Size 12+.

288. Same. *Rev.* "Pittsburg. Dry Goods, Groceries, Hardware & Notions." Two large and three small stars. Size 12+.

289. Cannon on wheels, with pile of shot, and thirteen stars. "1863." *Rev.* Wreath. "Army & Navy." Var. *b*. Size 12.

290. Cannon of a different design; thirteen stars. "Peace Maker." *Rev.* Flag, with liberty cap. "Stand by the flag. 1863." Size 12+.

291. Shield on star. "Pro Bono Publico. E. S. 1863." *Rev.* Wreath. "New York." Size 12+.

Class VII.—*Mottos.*

292–295. "Army and Navy." Var. *a*, *b*, *c*, *d*. Wreath. *Rev.* "The Federal Union, it must and shall be preserved." Thirteen stars. Size 12½.

296. "Constitution forever." *Rev.* Wreath. "Not one cent." Var. *a*. Two stars on each face. Size 12+.

297, 298. Same, without stars. Var. *p*, *q*. Size 12.

299. Same *obv.* *Rev.* "Erinnerung an 1863." Size 12+.

300. "Erinnerung an 1863." *Rev.* Wreath. "NOT One Cent. L. Roloff." Var. *s*. Size 12+.

301. "Liberty. 1863." Wreath. *Rev.* Wreath. "Union." Size 12.

302. "Remembrance of 1863." *Rev.* Wreath. "Not one cent." Var. *q*. Size 12+.

303. Same. *Rev.* Wreath. "One Country." Size 12.

The death of a member, the Rev. C. R. Demmé, on the 1st of September, at Philadelphia, aged 68 years, was announced by the Secretary.

The death of another member, the Rev. Calvin Pease, on the 17th instant, at Burlington, Vermont, was announced by Mr. Chase.

A communication was offered for publication in the Transactions, entitled, "On the Mathematical Probability of Accidental Linguistic Resemblances," by Pliny E. Chase, and referred to a committee, consisting of Professor Kendall, Professor Haldeman, and Dr. Coates.

A communication was offered for publication in the Transactions, entitled, "On the Comparative Etymology of the Yoruba Language," by Pliny E. Chase, and referred to a committee consisting of Professor Alexander, of Baltimore, Professor Haldeman, and Dr. Coates.

Pending nominations Nos. 503, 504 were read.

And the Society was adjourned.

Stated Meeting, October 2, 1863.

Present, twelve members.

Judge SHARSWOOD, Vice-President, in the Chair.

Dr. Henry Hartshorne, a recently elected member, was introduced to the President, and took his seat. Letters accepting membership were received from Professor Von Liebig, dated Munich, August 17th, and from Dr. R. M. S. Jackson, dated Knoxville, Tennessee, September 23d, 1863.

Letters acknowledging the receipt of publications were received from the Royal Academy of Brussels, May 16th and October 18th, 1862; from the Imperial Soc. Nat., Moscow, April 10th and 22d, and from the Maryland Historical Society, Baltimore, September 8th, 1863. A letter was re-

ceived from Professor A. D. Bache, inclosing a photograph of the Chevalier Lombardini, and a request for No. —— of the Proceedings.

Donations for the Library were received from the Essex Institute, the Royal Observatory, Brussels, the Royal Academy, Belgium, Prof. A. Quetelet, Prof. A. D. Bache, Messrs. Silliman and Dana, E. and F. N. Spon, Samuel Breck, Assistant Adjutant-General, United States, and from the City Council.

Donations to the Album were received of the photographs of the Chevalier Lombardini, from Gen. A. A. Humphreys, and of Mr. C. N. Bancker.

The committee on Mr. Chase's paper, entitled "On the Mathematical Probability of Accidental Linguistic Resemblances," reported in favor of its publication in the Transactions, which, on motion, was so ordered.

An obituary notice of the late member, Charles J. Ingersoll, was read by Judge Sharswood.

A complete biography of Charles Jared Ingersoll, would require to a considerable extent, a political history of the period during which he lived. His earnest action and patriotic spirit led him to take a part, and his ability and eloquence made that a prominent part, in all the events which were transpiring around him. But such is not the purpose of the obituary notices ordered by the American Philosophical Society of its deceased members. It is not an eulogium nor an extended memoir which they require, but a brief sketch, to be preserved in their archives, of the prominent facts of the life of the subject, and of the most striking traits of his character.

Mr. Ingersoll was born, on the 3d of October, 1782, in the city of Philadelphia. His father was one of the most distinguished of the leaders of the Old Bar of Philadelphia—a bar to be a member of which was itself a high distinction. He was also a delegate from the State of Pennsylvania to the Federal Convention of 1787, which formed the Constitution of the United States. His mother was the daughter of Charles Pettit, a member of Congress under the Articles of Confederation, and Commissary-General of Purchases to the Continental Army during the war of Independence.

Having completed his studies in preparation for the bar, under the direction of his father, he went abroad attached to the American Legation at the Court of St. James, and part of the family of Rufus

King, the minister. With him he travelled through Holland, Belgium, Switzerland, Germany, and France. Many years afterwards, in 1839, he wrote and published in a periodical an article headed "Europe Long Ago," a vivid though brief sketch of some of his recollections of England and France. In it are to be found crayon-like portraits of Fox, Erskine, and Napoleon, drawn from life by a keen observer, though with here and there a dash of caricature, interspersed amidst lively descriptions, in his own terse language, of "remarkable Holland, classic Flanders, romantic Switzerland, and transcendental Germany, left to a long repose in my old portfolio."

When he returned from Europe, he brought with him, as he afterwards stated on the floor of Congress in 1844, intelligence of the conclusion of the treaty by which the First Consul of France ceded to the United States, the extensive territory of Louisiana,—an event for good and for evil, reaching far and wide into future history. He saw in it then none but unmixed good; for he was one of those men of ardent patriotism and expanded views, who placed no limits to republican institutions under a Federal system, but the bounds of the continent itself.

He entered upon the practice of his profession, and soon established a character at the bar which insured him large business, and what he prized more, extended reputation. His first case in the Supreme Court of the United States, was in 1810, King *vs.* Delaware Insurance Company, 6 Cranch, 71,—an important insurance cause; and thence down to the period of his retiring from the bar, scarcely a volume of the reports of the decisions of the highest Federal tribunal is without contributions from his learning and ability. Subjects of mercantile and prize law largely engaged his attention, and the case of Evans *vs.* Eaton, 3 Wheaton, 404, upon a very difficult and nice question, arising under the patent laws of Congress, would, if it stood alone, be a lasting monument to his learning, ingenuity and legal acumen. The reports of the Federal Courts of this Circuit, as well of the Supreme Court of Pennsylvania, are replete with evidences of an extensive and important practice, sustained on his part by unwearied industry and patient research. It may be stated as a matter of curiosity, that the first case argued by him as counsel, which appears in the Reports of the Supreme Court of Pennsylvania, is Fox *vs.* Wilcocks, 1 Binn. 194, decided in 1806. Occasionally, too, his services were called for in the highest tribunals of our sister and neighbor States. But it was in the Federal Courts of this Circuit, under the presidency of those distinguished jurists Bushrod

Washington, Henry Baldwin, Richard Peters, and Joseph Hopkinson, that his severest professional labors were undergone, and his richest rewards earned.

In 1815, he was appointed Attorney of the United States for the Eastern District of Pennsylvania, under the administration of Mr. Madison, and continued to hold that office during the succeeding administrations of Mr. Monroe and Mr. John Quincy Adams, for the space of fourteen years.

The pages of Report books, however, furnish but scanty and unsatisfactory evidence of the professional career of a lawyer. It often happens that his most remarkable efforts, his most eloquent appeals, as well as his most able and learned arguments live only in the memory of contemporaries, who have had the good fortune to be present on the occasion which called them forth. Those only who have witnessed Mr. Ingersoll in the trial of an important cause, extending, as often happened, through several days—his tact in so opening it as to produce a favorable impression on the jury—the admirable order and arrangement with which the testimony was brought forward—his skill in skirmishing with his antagonist on questions of evidence—and the earnest, faithful and exhaustive summing up of the merits of his client's case—the humor, sarcasm, irony and invective with which he assailed the positions of his adversary, can have any adequate idea of Mr. Ingersoll's power as an advocate. The writer of this notice was present on an occasion when, at the conclusion of one of his most brilliant efforts, a crowded bar could not be restrained by the proprieties of the place from a momentary expression of admiration and applause.

Mr. Ingersoll's attention during all this period was largely devoted to the politics of the times. A remarkable characteristic of his entire course as a public man was what may be termed intense Americanism. His country, its institutions and men, as they had his warmest affection, naturally commanded with it his full approbation and confidence. It was not, however, a mere sentiment. He had seen with his own eyes other countries, observed the working of other systems, and been thrown in personal contact with their most distinguished men. He had scanned and studied the whole field with the pages of history, and the interpretation of Montesquieu, her minister and oracle, open before him. This is his response: "If a republic is small, it is destroyed by foreign enemies; if large, by internal corruption. This double inconvenience infects alike democracies and aristocracies, whether good or bad. The evil is in the thing

itself. There is no way in which it can be remedied. So it would seem that men must in the end be obliged to live under the government of one, if a species of constitution had not been devised which has all the internal advantages of a republic and external force of a monarchy. I speak of a Federal Republic." (Montesq. De l'Esprit des Lois, lib. ix, chap. 1.) This was the deliberate conclusion of Mr. Ingersoll's judgment; that sovereign states, each small in territory, and organized as a Representative Democracy, but combined together in a Federal Union, was the system most adapted to educate the individual citizen, develop the resources, secure the industry, and strengthen the defences of a country. This seemed to him the voice of history; for what form of government has stood longer, borne the storms of faction, weathered the tempests of foreign war, and at the same time afforded the citizen the political education which elevated his character, and made nations of great men, like the Federal League of Achaia, the Confederation of the Swiss Cantons, and the United Provinces of Holland? Right or wrong, this was the principle of Mr. Ingersoll's political life He cherished an unshaken confidence in the power of a Federal Union of States to extend the benefits of republican institutions over the widest extent of territory. He gave his cordial support to the Constitution of the United States, as on the whole the best compromise that could have been devised, and kept steadily in view as his polar star, "the support of the State governments in all their rights, as the most competent administrations for our domestic concerns, and the surest bulwarks against anti-republican tendencies; the preservation of the General Government in its whole constitutional vigor, as the sheet anchor of our peace at home and safety abroad." (Mr. Jefferson's Inaugural, March 4th, 1801.)

In 1808, Mr. Ingersoll published "A View of the Rights and Wrongs, Power and Policy of the United States of America." It was an elaborate and extended vindication of the rights of neutral commerce, on the subjects of contraband, paper blockade, and impressment, and plainly declared his conviction of the result to which the civilized nations of the world must come at last in the progress of reason and religion,—the immunity of all private property in war on the ocean, as it had already been well established in war on land. "If," said he, "a concert with Russia, France, Holland and Spain, all of whom with Denmark must desire it, could be effectuated for freeing the ocean of privateers and search ships, and directing by common agreement the operations of war against ships of war, leaving the

merchantman to the peaceable pursuit of his traffic, and if such a system could be secured without our being drawn into hostilities, it certainly were a consummation devoutly to be wished."

In 1809, appeared anonymously from his pen, Inchiquin, or The Jesuit's Letters; purporting to be the correspondence of a young Irishman educated at St. Omer's, banished on account of complicity in the rebellion of 1793, and temporarily sojourning in the United States. With some lively hits at the manners, amusements and style of living, as well as the plan of the Federal capital, then even more truly than now described as the City of Magnificent Distances, were joined interesting, impartial and life-like sketches of Washington, the elder Adams and Jefferson, the three first Presidents. The main design of the publication, pursued with a bold and manly independence of thought and criticism, then new in American writers, was the vindication of the character, politics, literature, and science of this country against the slanders of the English tourists and scribblers.

Inchiquin was severely handled in the Quarterly Review for January, 1814, and this produced a reply published anonymously by J. K. Paulding, New York, 1815.

In the early part of 1812, Mr. Ingersoll came forward at a town meeting in Philadelphia, with resolutions, supported by a strong and effective speech, in favor of war with Great Britain, which was declared in the following June. In October, of the same year, he was elected a member of the Thirteenth Congress, whose term commenced March 4th, 1813. An extra session was called for May 24th, 1813, and that Congress sat almost continuously from that time until March 3d, 1815. It was an illustrious body. Without referring to the Senate at all, nor pretending to call over the full roll of great men who stood on the floor of the House of Representatives with Mr. Ingersoll, there were John Randolph, Henry Clay, William Lowndes, John C. Calhoun, Nathaniel Macon, and John W. Eppes. Mr. Ingersoll's first effort was in Committee of the Whole, June 29th, 1813, on a resolution submitted by him to impose a tax on incomes and inheritances. His great speech in defence of the policy of the war, into which he seemed to throw all his powers of logic, sarcasm and rhetoric, was delivered in Committee of the Whole, on the Loan Bill, February 14th and 15th, 1814. Nothing in the annals of parliamentary eloquence exceeds the weight of the torrent with which he bore down upon the employment by the British of Indian savages as auxiliaries. "So long ago as 1792 was this iniquity in preparation. Within the last two years, every disguise has been thrown off and

it stands forward before the world in all its horrid incarnation of avowal. Before General Hull's capitulation, the first blow that was struck in the present hostilities came from the Indians deep in the Northwest, against the post of Mackinaw. And what was that unhappy man's extenuation of his surrender? That the savages were swarming for his destruction, pouring down upon his army from the west and north, and hastening to their annihilation." "I solemnly protest," he exclaimed, "that my inconsiderable knowledge suggests no oblation ever laid on the altar of human malignity and vindictiveness to be compared with this subornation of our Indians by the English, who boast of their superior religion and charity, who have sent out more missionaries of late for the salvation of distant hemispheres, than all the rest of the world put together, against us Americans, their descendants, their flesh and blood, through the instrumentality of those savages, whom by every liberality and study, we have labored to humanize and ameliorate, and whom we could at any moment either extirpate or expel from the neighborhood of our frontier. It is, sir, an excess of wrong, which absolutely flings the hurdle and guillotine behind, and occupies the most conspicuous place in the representation of our most unnatural passions."

We cannot pretend to follow Mr. Ingersoll through his entire career in that Congress, in which among the men, tallest in intellectual stature which the Union has ever produced, he exercised a wide and commanding influence, and bore his share in all the most important debates. He occupied, by the appointment of the Speaker, Mr. Clay, the position of Chairman of the Judiciary Committee, and was a member also of the Committee of Foreign Relations, of which Mr. Calhoun was the Chairman.

After the close of this Congress, Mr. Ingersoll did not occupy a seat in any public deliberative body until 1830, when he was elected a Representative of the City of Philadelphia in the General Assembly of this Commonwealth. He had indeed, in the year 1825, attended what in our practical politics may be termed a quasi public body—a convention of delegates from all parts of the Commonwealth—to consider and adopt measures for the improvement of the State by the construction of navigable canals. In this convention, Mr. Ingersoll introduced a resolution in favor of the use of railroads, with locomotive steam-engines, in which he was seconded by Mr. Henry Vethake; but the motion was voted down by a large majority. In the Legislature he occupied the post of Chairman of the Standing Committee

on Internal Improvements, and made an able report on the subject. He introduced resolutions relative to the principles of the commercial intercourse of the United States with foreign countries, arguing that a system should be inaugurated by treaties on the great principle of national equality and equal reciprocity, reducing or abolishing imposts, and allowing the products of one country to find free ingress to every other.

He was, in the first instance, warmly in favor of the protection of domestic manufactures by the imposition of discriminating duties on imports by the Federal Congress, under the power contained in the Constitution. In this view, he attended and took an active part in the proceedings of several conventions, one at Harrisburg, in 1827, another at New York, in 1829, and still another at the last-named place, in 1831. At this convention of 1831 he was one of a sub-committee of three to prepare the address to the people. "This address, as far as the last paragraph on page 21, was composed by Warren Dutton, of Boston, with some parts contributed by John P. Kennedy, of Baltimore; from that paragraph to the end by C. J. I., with some contributions by Mr. Kennedy." (Note in Mr. Ingersoll's writing on his copy of the address.) That he regarded such governmental protection as necessary only for the first beginning of manufactures is evident from his urging at the New York convention the withdrawal of the duties upon coarse cottons, a proposition by no means agreeable to those interested. In a discourse delivered by him before the New York Institute, in 1835, he maintained that liberty, Union, and labor, protected everywhere by equal and just laws, are the most effectual encouragement of domestic industry.

It may be noticed that upon a kindred question of political economy Mr. Ingersoll was very explicit in his views. He was a decided bullionist. He looked at banks and paper money as inimical to the purity of our political institutions, and as paving the way for a kind of government which, under the forms of a representative democracy, would in truth be a plutocratic oligarchy,—the worst because the most selfish of all governments. For this reason he took an active part in favor of the measures of the administration against the Bank of the United States, though upon terms of the kindest friendship with Mr. Nicholas Biddle, and at a time when to do so in Philadelphia, required a gentleman to go through no common social ordeal.

We must rapidly run over the succeeding events of Mr. Ingersoll's political career. It having been determined by a vote of the people

that a Convention should be called for the purpose of proposing amendments to the State Constitution, he was elected a delegate to that body from the County of Philadelphia, in November, 1836, and took his seat at the opening of its sessions, May 2d, 1837. Here, as in every other deliberative body with which he was ever connected, he entered upon and performed his duties with a zeal, ability, and eloquence, which ranked him amongst the foremost of its members. Each party had carefully put forward its best and most popular men for election, and an amount of talent was congregated on its floor, certainly not to be found or expected in ordinary legislative assemblies. Its importance in all its aspects upon the future of the Commonwealth was fully appreciated, and what added much to the interest of its proceedings was, that upon coming together it appeared that the members stood, on a party vote, equally divided; one being neutral. The sessions of the Convention continued at Harrisburg until November 23d, 1837, and at Philadelphia from November 28th, 1837, until February 22d, 1838, when its labors were brought to a close. During this long period every topic which either directly or indirectly bore upon economy, legislation or government underwent full discussion. Mr. Ingersoll seems to have specially devoted his attention to the subjects of Currency and Education. His reports on these two subjects were elaborate and full. His speech on the Judicial Tenure was one in which he was able, with a large mass of anecdote and information, to join a striking display of the peculiar characteristics of his oratory.

Mr. Ingersoll, in October, 1840, was elected a member of the 27th Congress of the United States, and successively of the 28th, 29th and 30th Congresses, serving a period of eight years in that body. Thus, as his first service in Congress had been during the war of 1812, it was his fortune to be a member of the same body during another period of foreign war. He made many distinguished efforts during this long period of Congressional service. A part of the time he occupied one of the most important positions in the House, that of Chairman of the Standing Committee on Foreign Relations, and made several able reports in that capacity. After his retirement from Congress, he still continued to take an active interest in political affairs, and from time to time, to give his views of the great questions agitating the country. These are entirely too numerous to be here noticed in detail.

Let us turn to the more purely literary productions of Mr. Ingersoll's pen, and for this purpose we must revert to an earlier period of

his career. One of his first essays was a tragedy, "Edwin and Elgiva," which was performed with some success and published; and subsequently, a production of the same kind, "Julian, the Apostate," much more elaborate, was committed by him to the press.

On the 18th of October, 1823, he delivered the annual oration before this Society, being a Philosophical Discourse on the Influence of America on the Mind. It attracted extensive notice abroad, and was reviewed in the Révue Encyclopédique of France. On the 1st of October, 1824, at the memorable meeting of the Society, which was attended by our illustrious fellow-member General Lafayette, during that last visit of his to the United States, so remarkable an ovation to the hero of republican liberty in two worlds, a communication was read by Mr. Ingersoll, On the Improvement of Government. At a much later period, January 5th, 1855, he read before the Society, by appointment, a short and very interesting obituary notice of Joseph Bonaparte. On the 4th of July, 1832, he delivered an oration before the Philadelphia Association for celebrating the Anniversary of our Independence without Distinction of Party. It was a vivid sketch of the effects of the American revolution on the mind, manners, wealth and progress of the United States. This also attracted attention abroad, and was quoted by Bulwer in his novel of Rienzi.

In 1817, Mr. Ingersoll translated from the French, and published in Hall's Law Journal, a tract upon the freedom of the navigation and commerce of neutral nations during war, considered according to the laws of all nations, that of Europe and treaties; an historical and juridical essay to serve as an explanation of the disputes between belligerent powers and neutral states, on the subject of the freedom of maritime commerce. This was a subject which he always had much at heart, and to which at different periods of his life he gave great attention. In January, 1845, he published in the American Law Magazine, then edited by the writer of this notice, an article on the Law of Foreign Missions. In explanation of its origin and design, he said : "Several years ago, by way of evening employment in the country, I translated Bynkershœd's twenty-four books de Foro Legatorum, assisted by Barbeyrac's paraphrase, in turning very unclassical and difficult modern Latin into English. Finding my work when done but an imperfect view of the subject, and becoming pleased with it, I consulted Wicquefort, Bielfield, Vattel, Grotius, Merlin, Martin, and whatever other writers upon it I could lay my hands on. Finally, the following introduction was

composed to the knowledge of an important branch of jurisdiction, but little cultivated, whose principles and practice, fully presented, form a useful and interesting portion of law, seeming to supplant all other law and to exist without law." In this introduction, after tracing the history of the law of legations to the earliest times, and discussing in a succinct and clear method the well-established principles in regard to the inviolability of ambassadors and other public ministers, he concludes as follows: "It has long been among my fondest fancies, that this transatlantic country, with its free, benign, and pacific institutions, should deem it a part of American destiny to meliorate the law of nations by giving greater liberty to the sea, greater extension to commerce, and thereby diminishing the occasions of war. In this amelioration, foreign missions must perform important parts. The Federal Constitution, by elevating consuls to the rank of diplomatic agents as respects jurisdiction, made a first and important step towards this great change. Government, especially the Federal judiciary, may accomplish the rest. In nothing is the literature of English law so deficient as that of nations. America must make amends for it. Independence of bad precedents, offspring of angry conflicts, recurrence to first principles, restoration without innovation, by American judges and foreign ministers, may render this country the renovator, the arbiter and founder of a law of nations promoting general peace."

In 1835, a dispute, which arose between the City of Philadelphia and the Schuylkill Navigation Company, turned his attention to a subject of the class in which he especially delighted, and he published a short work on "River Rights," in which he discussed that important head of law with his accustomed research and ability.

In the year 1845, Mr. Ingersoll committed to the press the first volume of his "Historical Sketch of the Second War between the United States of America and Great Britain, declared by Act of Congress the 18th of June, 1812, and concluded by peace the 15th February, 1815," followed by a second volume in 1849, and completed by two additional volumes in 1852. In the preparation of this work he engaged *con amore*. He was not only a contemporary and interested spectator of all the events of the period, but could say with truth, *Quorum pars magna fui*. He knew personally the principal actors in the scene; he had studied closely the political complications of the plot, and wrote his history not during the heat of the contest, but thirty years afterwards, in the spirit of a calm, unimpassioned judge. It is this which gives the greatest interest and importance

to this contribution to American literature. Throughout the work appears and reappears strongly that intense Americanism to which we have before referred, showing that with the most ardent attachment to popular democratic forms of government, there went hand and hand, the sincere and deep convictions of his judgment, that with so vast a territory such institutions could only be permanent upon the basis of a Federal Union.

After the publication of this work, Mr. Ingersoll projected a History of the Territorial Acquisitions of the United States, and had made some progress in it when he was arrested by the hand of death. This event occurred after a short illness of inflammation of the lungs on the 14th of May, 1862, in the eightieth year of his age.

It will not be easy to add anything like a portraiture of Mr. Ingersoll within the limits proper for such a notice as the laws of the Society contemplate. Physically, he was slightly made, but of well-turned form and most gentlemanlike appearance. It is said, though I cannot vouch for the fact, that when elected to Congress in 1813, then thirty-one years of age, his appearance was so youthful that the doorkeeper at first discredited his assertion that he was a member, and refused him admittance. He looked all his life many years younger than he really was. In his eightieth year he might well have passed for a man of fifty, erect, agile, scarce a hair turned gray or tooth lost. He possessed indeed a most excellent constitution, which he had preserved by the strictest temperance in meat and drink, and by regular exercise. That he was an industrious student and constant reader all his life, the foregoing sketch, not pretending to give an account of all or even the greater part of his literary, political, and professional labors, will amply evince. He retained his intellectual faculties in full vigor up to the time of his death. He was a free and attractive conversationist, and one could rarely leave a company of which he had been a part, without carrying with him something well thought or well said by him. An Ex-President of the United States, who had represented this country at two foreign courts, and who largely cultivated the society of distinguished men at home and abroad, used to say that, when in the vein, Mr. Ingersoll was the most agreeable man he had ever met at a dinner-table. He was affable and courteous to all who approached him ; in this respect agreeably disappointing those who had formed wrong notions of him from the partisan scribblers of the day. He was ardent and outspoken as to his political opinions, and thereby gave a handle to his opponents to represent him as radical and extreme, which he never was.

While his freedom and boldness won the affection and confidence of those who sympathized in his views, it aroused the ire of adverse partisans, and embittered the opposition to him. Hence he had to exercise to a large degree a virtue very essential in a statesman depending for his position and influence upon the popular will, and which on one occasion he himself called "the endurance of manurance."

As a writer, while all his earlier compositions are distinguished by great purity, tenderness, and elegance of language, a style gradually grew upon him, which cannot please a correct taste. It is, however, entirely original. In his speeches and conversation it was easy and diffuse. In writing and re-writing, which was always his habit, with an anxiety to condense, he was not able wholly to reject the collateral subjects of illustration, which presented themselves. His style is not a compound of artificial epithets and complicated convolutions, but rapid, broken, and rugged, as the result of an effort to press too much in a given space.

In his private relations, Mr. Ingersoll possessed the affection and veneration of all about him. He had a warm and affectionate nature, though a stranger would be apt to conclude from his exterior that he was cold. He was sensitive upon such subjects, and shrank from observation. It was so too as to his religious feelings and opinions,—he obtruded them upon no one. He was a sincere and firm believer in the truth of Christianity, without the slightest taint of bigotry or fanaticism, and attached to the forms and worship of the Protestant Episcopal Church, in the communion of which he died.

Mr. Chase made a communication in reply to the following questions of Mr. Dubois.

"What number of vowel-sounds are there in other languages, which are foreign to the English language?

"Are there any possible vowel-sounds, which are not used in any language?"

No writer that I have ever met with, has treated of the various sounds of speech so fully and satisfactorily, as Professor Haldeman in his Analytic Orthography, and in framing answers to the two questions, I shall be largely indebted to his work. (Trans. A. P. S., Vol. XI.)

According to his definitions, "Vowels are sounds of the uninterrupted voice, the distinction between them being due to slight

modifications, chiefly of the cavity of the mouth and pharynx. Vowels are *pure* or normal; *nasal*, as some of the French, Portuguese, and Polish vowels are; *whispered*, of which some of the aboriginal American languages afford examples; *independent* (of expiration, inspiration, or voice), being a vowel effect succeeding a clack; and *glottal*, in which the vowel is accompanied by a scraping effect along the rather close glottis. Its type is the Hebrew and Arabic *ain*. Consonants are the results of interrupting the vocalized or unvocalized breath." (Hald. § 156–7.)

Grammarians have usually admitted an intermediate class of semi-vowels, and the gradation is so imperceptible from the pure to the impure vowels, and from the impure vowels to the consonants, that a consideration of the consonant sounds is almost necessarily involved in any inquiry about the vowels.

The Sanscrit grammarians recognized three primary or pure vowels: 1. The full â (a); 2. The glottally interrupted í (i); 3. The labially interrupted ú (ŭ). Of these the a or ŭ is the purest, and, perhaps, the only one that is strictly entitled to the name of vowel. The u glides imperceptibly into the o, the i into the e, the a into â and ŭ, thus giving Haldeman's groups of 1, í e a o u; 2, í e ŭ or â ou.

The three primitives, i a u, with the modifications of a (â and ŭ), are spoken with tolerable uniformity; the others tend to become diphthongal ei or eŭ, ou or oŭ. This tendency in the English ā and ō, was happily noticed by Dr. B. H. Coates, in the note to Professor Tafel's communication on the Laws of English Orthography and Pronunciation. (Proc. A. P. S., V. IX., p. 54.)

The Sanscrit grammarians were aware of the same peculiarity in their own language, but their delicacy of analysis has not been generally appreciated by others. Thus Wilkins says (p. 5):

"ē, though classed among diphthongs, differs not from the simple sound of e in where (ă ŭ). . . . . It is said to be a compound of *a* and *i*.

"ō differs not from our *o* held long, as in *stone* (ō u); though it is said to be a diphthong composed of *a* and *u*."

Even our Saxon ancestors showed their perception of vocal combinations, by expressing with two letters sounds that the mistaken reformers of our day would fain denote by a single character, *e. g.*, *they*, *their*. There are undoubtedly vowel-sounds analogous to our ā, ō, and even to our ī, which are not diphthongs, but such is the flexibility of our vocal organs, and so fixed is the habit of rapid

change, that it requires a strong effort to sustain them without corruption by a leaning either to a closer or to a more open sound. And when they are combined with consonants of a different contact from their own, it is often absolutely impossible to avoid giving them a diphthongal character, except by the trick of an intervening nasal, or by an abrupt staccato like the Chinese ji or yap shing. The reasons for this impossibility may be easily shown.

U is a labial vowel,—A, a palatal,—and I, a guttural. [Haldeman, § 159.] As long as there is sufficient opening between the lips to allow of the formation of the u sound, or of any nasal sound, the consonants of any contact, labial, dental, palatal, or guttural, can be formed without difficulty. U and English *ng* can therefore be combined with any consonant whatever, without losing their distinctive character.

But if we attempt to combine any other vowel with any except its cognate consonants, just before the consonantal interruption is made, either the corresponding vowel, or a nasal, or a *u*, must be produced. Ape thus becomes āŭp, ache āĕk, or āŭk, ode ōŭd, eat ēŭt, eve ēŭv, &c. It is often difficult to discover the precise combination of sounds, but I think it will always be found that such a combination exists.

The number of possible secondary or intermediate vowels between the broad open á, and the close í and ú, is *infinite;* but by making a limited number of divisions, the vowel sounds of different languages can be compared with sufficient accuracy. Professor Haldeman makes fourteen such divisions on each side of á, indicating twenty-nine distinct pure vowel sounds, thirteen of which are foreign to the English language, and, perhaps, four out of the thirteen are not represented in any language. [§ 369, sqq.] These thirteen foreign vowels are:

1. The Italian "*o aperto,*" between b*a*ld and b*o*ld, as in poco.
2. French o between *o*we and the o aperto, as in poste, note.
3–4. Two unrepresented sounds between *o*bey and 5.
5. Italian "*o chiuso,*" as in conca. [o approaching u.]
6. Ossetisch V, between 5 and Ger. ö or ü.
7. Ostjak and Iroquoi *ω*, somewhat like o in m*o*i.
8. Suabian a, perhaps corresponding to Sanscrit *a*, between *u*rn and *a*dd.
9-10. Two unrepresented sounds between *a*dd and No. 11.
11. Suabian ε, a little more open than th*e*re.
12. Gudjrat'hi *E*, between *e*bb and *e*ight.

13. Hungarian e, between judgment and *it*.

There are also ten foreign vowels intermediate "between those of the throat and the lip side of the scale, and akin to both." [§ 430.] The extremes are ö in könig, and ü in übel. Of these sounds two are common to French and German, one is French, one Russian, one Swedish, one Samojedic, one Alsacian, and three are unrepresented.

Perhaps the simplest of the impure vowels (or sounds which are otherwise modified than by the size and shape of the oral cavity), are the guttural *ch*, and Welsh u (y), akin to French u, but made "with the tongue between the teeth" [§ 439], and related to Welsh ll, nearly as u to v.

In the class of tongue-modified vowels should also be included the Sanscrit ṛ and ḷr.

Cary, in his "Sungskirt Grammar," represents the ṛ sound by *ir* instead of *ri*, which is the substitute adopted by most of the more recent writers upon the Sanscrit language. Dr. Joseph Thomas, who visited India for the purpose of studying the pronunciation of the natives, says that *r* is neither *ir* nor *ri*, but a simple soft burr, or rolled vowel. The l*r* appears to be a kind of palatal u. The affinity of u, r, and l, is shown by the various attempts of the Chinese and of children to pronounce sounds that they are unable to form.

If the number of possible pure vowels is infinite, the same must be true *a fortiori* of the modified vowels, and among the vocalized or semi-vocalized aspirates, sibilants, nasals, and liquids, an immense number of sounds might readily be found, which are used neither in our own nor in any other language.

Professor Haldeman made some remarks upon the same subject, giving illustrations of whispered vowels.

Pending nominations Nos. 503, 504, were read.

Dr. Coates called the attention of the Society to the part of the Catalogue already printed, and moved that copies be presented to corresponding Societies. On motion of Prof. Cresson, the motion of Dr. Coates was laid on the table. Mr. Chase moved that the Catalogue as far as printed, be distributed to subscribers. On motion of Prof. Cresson, it was referred to the Committee on the Library, with instructions to report.

And the Society was adjourned.

Stated Meeting, October 16, 1863.

Present, seven members.

Prof. A. D. BACHE, in the Chair.

Letters acknowledging publications, were received from John S. Stevenson, Librarian of Congress, and Richard Kippist; from J. H. Cook, asking information; and from John Penington & Son, with a notice of new publications.

Donations for the Library were received from the British Association, Royal Geographical, Linnean, and Geological Societies of London, the Geological Society of Dublin, the Rev. S. Haughton, J. W. Dawson, of Montreal, the Connecticut Historical Society, the Academy of Natural Sciences, and Blanchard & Lea, of Philadelphia.

Mr. Peale laid before the Society several specimens of the *Geastrum hygrometricum*, both in the living and in the dried states, and described the growth and habits of the plant. He also exhibited minute cryptogams resembling bird's nests and eggs.

The following persons were then duly elected members of the Society.

Robert Briggs, Civil Engineer, of Philadelphia.

Joseph Lesley, Geologist, of Philadelphia.

And the Society was adjourned.

Stated Meeting, November 6, 1863.

Present, sixteen members.

Dr. WOOD, President, in the Chair.

Mr. Briggs, Dr. Washburne, and Dr. Penrose, recently elected members, were introduced to the President, and took their seats.

Letters announcing donations to this Society were read

from the Royal Academy of Lisbon, July 18th; the Imperial Society of Naturalists at Moscow, June 1–13; the Natural Historical Union at Riga, April 3–15; and the Royal Danish Society, February 1st, 1863.

Letters acknowledging the receipt of publications were received from the Society of Antiquaries of Scotland, Dec. 1862, and March, 1863; the Imperial Observatory at Pulkowa, July 15th; the Royal Society, London, August 13th; the Society of Antiquaries, London, October 16th, 1863.

A letter was read from the Geological Society of Dublin, October 3d, asking to be supplied with missing numbers of the Transactions and Proceedings.

A letter was received from Dr. Renard of Moscow, requesting that the publications of this Society may be sent to the Public Museum of that city. On motion, the Librarian was instructed to place the Museum upon the list of corresponding Societies.

Donations for the Library were announced from Colonel Sir Henry James, the Royal Society at London, the Chemical Society, the British Meteorological Society, the Imperial Academy at St. Petersburg, the Central Observatory of Russia, the Physico-Oekonom. Society in Königsberg, the Royal Danish Society, the Imperial Society of Naturalists in Moscow, the Royal Academy at Lisbon, the Geological Institute at Vienna, the Royal Academy at Berlin, the Upper Lausatian Society at Görlitz, the Natural History Union at Riga, the Ecole des Mines, Professor Delesse of Paris, the Horticultural Society at Berlin, the Franklin Institute, Dr. F. Bache, J. W. Bouton, of New York, and Dr. Roerig.

And the Society was adjourned.

Stated Meeting, November 20, 1863.

Present, fifteen members.

Prof. CRESSON, Vice-President, in the Chair.

A letter accepting membership was received from Prof. A. Delesse, dated Paris, November 3d, 1863.

Donations to the Library were received from the Royal Astronomical Society at London, the Department of Agricultyre at Washington, the Franklin Institute, and Blanchard & Lea of Philadelphia.

The Secretary announced the deaths of T. E. Blackwell, of London, and Jacob Grimm, of Berlin, late members of the Society.

Mr. Cornelius exhibited and explained to the Society his three instruments for lighting gas by means of the Electrophorus, and also his arrangements for rendering uniform the supply of gas to the burners.

Messrs. Cornelius and Briggs made some remarks upon the manufacture of hard rubber, and its use for electrical and other purposes.

Dr. Coates called the attention of the Society to the so-called *tea plant* of Pennsylvania, and quoted the investigations of M. Maische, to prove that it contained no substance resembling *thein*. Mr. James said that the plant was doubtless the *Ceanothus Americanus*. The discussion of the subject was continued by other members present.

The minutes of the last meeting of officers and members of Council were read.

On motion of Mr. Peale, the Curators were authorized to exchange the intestinal calculus in the Cabinet of the Society, for certain stone implements in the Museum of the University of Pennsylvania.

And the Society was adjourned.

Stated Meeting, December 4th, **1863.**

Present, eighteen members.

President, Dr. WOOD, in the Chair.

Professor McClune, recently elected a member, was introduced to the President, and took his seat.

Letters were received from the Massachusetts Historical Society, acknowledging publications, and from M. Boucher de Perthes, of Abbeville, in France, announcing a donation to the Society.

Donations for the Library were received from Profs. Silliman and Dana, the Essex Institute, Prof. Geo. Ticknor, and the London Reader.

Mr. Briggs made a communication on the application of mathematics to the screw, pointing out certain striking coincidences between the results as computed and as obtained by experiment.

Mr. Briggs wished to communicate to the Society some curious results which had been obtained in an investigation he had made of the strength and the application of forces to the screw-bolt as ordinarily in use by mechanics. He had found first, that the proportions established *by practice* as to the number of threads upon any given diameter of bolt, were those which could be derived from a straight line formula. Thus, Mr. Whitworth's result in collating the practice of English engineers in this respect, could be (with the exception of the half inch bolt, which was too coarse), expressed by the formula $\frac{1}{ad+c}$, where,

$d =$ diameter of belt.
$a =$ a coefficient.
$c =$ a constant.

On proceeding further in the investigation of the subject, he found that every part of the bolt, the diameter of the root of the threads, the heads, the proportions of the nut, &c., was capable of being expressed in a general formula, instead of taking each particular size in the calculations he was desirous of instituting. The general formula of the screw is laid down in most works on applied mechanics, and has the following cumbrous shape.

Let P = the force expended on the arm of the wrench.

a = the length of arm of wrench.

$\dot{a}$ = the angle of inclination of thread or the developed inclined plane of the screw.

β = one half the angle of the thread itself.

φ = the coefficient of friction on the thread surface.

φ' = the " " " nut "

D = diameter of nut outside.

d = " " bolt.

d_2 = " " root of thread.

Q = load on screw parallel to axis, or in other words, the strain on the bolt, thus:

$$Pa = Q \left\{ \left[\frac{\tan \dot{a} \pm \varphi \sqrt{1 + \operatorname{Cos}^2 \dot{a}.\ \tan^2 \beta}}{1 \mp \varphi \tan \dot{a} \sqrt{1 + \operatorname{Cos}^2 \dot{a}.\ \tan^2 \beta}} \right] \frac{d_2}{2} + \varphi \frac{1}{3} \left[\frac{D^3 - d^3}{D^2 - d^2} \right] \right\}$$

the first member of the coefficient of Q being derived from the inclined plane and the friction of the thread, and the second part from the friction of the nut on its seat.

This cumbrous equation, by having inserted in it definite values for φ and φ' and for β, and the values given by the general formula functions of ad+c before alluded to, underwent the most astonishing reduction to the form

$$Pa = Q\ (Ad + C).$$

where A = a coefficient and C a constant.

Of course, A and C have values differing with different values of φ, φ' and β and also changed by the $\mp \pm$ terms for screwing and unscrewing. But as, in practice, the value of angle

β is fixed at 30°

φ is fixed at about 0.1

φ' " " 0.15

and the value of a in the first formula is established at 0.096

" " c at 0.026 ∴.

$$N = \frac{1}{0.096\ d + 0.026}$$

and the value of D = 1.734 d+0.1445

it results that the formula for summing up becomes

$$\frac{Pa}{Q} = 0.164\ d + 0.008$$

and for unscrewing

$\frac{Pa}{Q} = 0.133\ d$ — a constant so small that it can be neglected.

The investigation went further into the whole consideration of

forces on a bolt, comparison of load per square inch with friction, torsion, combined torsion and tension, strength of nuts, &c. &c. The above gives the result in the more striking and important particulars.

Dr. Wood having requested Judge Sharswood to take the chair, gave a sketch of the water-works of Madrid. Mr. Fraley discussed the subject of an increased supply of water for the city of Philadelphia, advocating the construction of additional reservoirs at various points on the Schuylkill Heights, to be filled from the river by steam-engines. Mr. Trego followed with remarks on the same subject, and Dr. Hays with others, upon the degree of purity of the river water.

The Treasurer's annual report was read and referred to the Finance Committee.

The Publication Committee presented their annual report, as follows: "Since the last report, Part Three (3) of Volume XII has been printed and distributed. The number of subscribers has not materially altered during the past year. The amount received from subscription to the Transactions has been in excess of last year; nevertheless the arrears due are on the increase. The amount paid on publications for the past year is fourteen hundred and thirty dollars and fifty-three cents ($1430 53), of which nine hundred and eighty-six dollars and ninety-two cents ($986 92),* was on account of the Transactions for the last and previous numbers. The receipts amount to one hundred and fifty-two dollars and ninety-two cents ($152 92)."

The report was accepted, and the Society was adjourned.

* Viz., $354 02, cost of Part III, Vol. XII. $632 90, see report Oct. 25th, 1862.

Stated Meeting, December 18th, 1863.

Present, fourteen members.

Dr. Wood, President, in the Chair.

Letters acknowledging publications were received from the British Museum, November 26, and the Society of Antiquaries, London, November 20th, 1863.

A letter from the Secretary of the Smithsonian Institution, December 12th, was received, asking for the loan of ethnological specimens in the cabinet, for the purpose of having plaster casts of them made for the cabinet of the Institution. On motion, this communication was referred to the Curators, with power to grant the request.

A letter from Prof. Zantedeschi, dated Padua, November 20, was received, together with a copy of an extract from the proceedings of the Institute of Science of Venice, containing an inedited letter of Carlini. The communication was, on motion, referred to the Secretaries.

Alla Celebre Societa' Filosofica Americana in Filadelfia.

Della Fotografia dei prototipi del mondo esteriore.

Nell' adunanza del 24 Novembre, 1862, io aveva l'onore di comunicare all' I. R. Istituto Veneto una lettera inedita direttami dall' astronomo e geometra Francesco Carlini *intorno ad un piano di di meteorologia ed all' applicazione della camera lucida al cannocchiale per ottenere dei panorami di monti in grande scala e della maggiore esattezza,* e poneva fine alla mia comunicazione con queste precise parole: "I fotografi amora troveranno utilissima l'applicazione della camera lucida al cannocchiale pei panorami delle vedute lontane, con tutte quelle degradazioni della prospettiva aerea, che solo la natura geometricamente sa dare. Alla carta comune de' disegni non hanno che a sostituire la carta *sensibilizzata.*"

A proporre questa applicazione io sono stato condotto dal principio filosofico: l'immagine obbiettiva non e' che l'immagine subbiettiva riflessa, riferita dallo spirito all' oggetto, dal quale si deriva l'eccittamento delle irradiazioni. E percio' fotografando l'immagine subbiettiva, si fotografa l'immagine subbiettiva, o della retina. Applicato l' occhio alla camera lucida, esso invia dal suo fondo i razzi chimici sul piano della carta fotografica, che vi producono un' impressone,

ad una immagine, la quale altro non a' che quella della retina direttamente fotografata. Il dubbio, che potrebbe insorgere contro di questa applicazione, devesi ripetere dalla possibilita' di fotografare un' immagine esistente sulla retina dell' occhio. È noto ai fisiologi, che l'impressione del raggio sulla retina dell' occhio non è istantanea, ma persistente per qualite frazione di minuto secondo. Rimaneva a ricercarsi, se questa persistenza fosse duratura anche dopo la morte dell' uomo. Dalle dottrine fisiologiche si poteva argomentare affermativamente; perchè, estinta la vita sensitiva, le forze chimiche riessono prevalenti alle fisiologiche. Ma ĕ merito del Sigr. Dottor Sandford di Boston di avere per il primo fotografata l'immagine persistente nella retina di un uomo di fresco ucciso. Ecco come viene narrata dai Giornali questa maravigliosa scoperta. Si trattava di procurarsi l'immagine di un assassino rimasto sconoscinto, facendo, il piu' presto possibile dopo il delitto, la fotografia degli' occhi della vittima. Venne ucciso un certo Beardsley da ignoto assassino. H. Dr. Sandford con una leggera soluzione di atropa belladonna, sriluppo' la pupilla e tosto fere fotografare l'occhio ed appresso con un microscopio esamino' la carta fotografata e vi discopri la figura e le vesti dell' uccissore. Quantunque impertanto sul piano della carta fotografica non giunga, a mezzo della camera lucida di Wollaston applicata al cannocchiale, alcun raggio proveniente direttamente dall' oculare del cannocchiale, vi giungono tuttavia quelli dell' immagine persistente sulla retina dell' occhio. Dopo cio' sembra potersi fotografare anche colla semplice camera lucida non applicata al cannocchiale; perchè si fotografa sempre l'immagine impressa sulla retina, nell' atto che si riferisce sulla carta preparata l'immagine di una vedata; come evidentemente è dimostrato dalla posizione dell' immagine detta obbiettiva, che è sempre rivolta all'occhio, o alla immagine subbiettiva della retina, originale tipo del mondo esteriore.

L'argomento mi sembra della piu' alta importanza pei filosofi, fisiologi e fotografi; e percio' non dubito punto, ch'esso richiamerà l'attenzione della nostra Societa'.

Sono co' sensi di altissima stima e profondo rispetto.

PADOVA, il 20 di Novembre, 1863.

Donations for the library were received from Prof. Morlot, of Lausanne, the Royal Astronomical Society, the British Meteorological Society, and the Society of Arts, in London, Blanchard & Lea, and the Colonization Herald.

Mr. Chase made some remarks on the diurnal variations of the barometer:

The existence of daily barometric tides has been known for more than a hundred and fifty years; but their cause is still a matter of dispute. The principal theories that have been brought forward for their explanation attribute them to—

1. Variations of temperature.
2. Variations of moisture.
3. Formation and dissipation of clouds.
4. Electrical action of the sun.
5. Gravitation.
6. Centrifugal force.
7. "Rotation of the earth and its connection with the solar system." [*W. C. Redfield*, in Silliman's Journal, vol. 25, p. 129.]

No one has attempted to point out any minute or precise correspondence between theory and observation, nor to furnish any satisfactory demonstration of the connection between the observed phenomena and their supposed causes.

The prevailing sentiment of the day appears to incline towards the temperature-theory, notwithstanding the confessedly inexplicable difficulties that attend it. James Hudson (London Phil. Trans., 1832) points out "the general relation between the barometrical changes and the variations of temperature;" but he admits that the relation "appears to be DIRECT during the morning hours, and INVERSE during those of the day and evening." Sir John Herschel says that "heat causes diurnal variations; but the effects surpass the natural operation of those causes." Prof. Espy (4th Meteorol. Report, p. 12) attempts to reconcile the American observations with his view of the heat-theory. His explanations, though plausible, are unsatisfactory, and will not bear the test of rigid scrutiny. It seems evident, therefore, that the variations of the barometer cannot be accounted for by variations of temperature; for, 1st, their regularity is not perceived until all the *known* effects of temperature have been eliminated; 2d, they occur in all climates and at all seasons; 3d, opposite effects are produced at different times, under the same average temperature. Thus, at St. Helena, the mean of three years' hourly observations gives the following average barometric heights:

From 12h. to 0h. 28·2801 in.	From 6h. to 18h. 28·2838 in.
From 0h. to 12h. 28·2861 in.	From 18h. to 6h. 28·2784 in.

The upper lines evidently embrace the warmest parts of the day, and the lower lines the coolest. Dividing the day from noon to midnight, the barometer is highest when the thermometer is highest; but in the second division the high barometer prevails during the coolest half of the day.

Each of the other enumerated causes undoubtedly exerts an influence which must be carefully investigated before we can obtain a thorough knowledge of the laws which control the atmosphere. Such an investigation will probably show a mutual connection, through which all the secondary causes may be referred to a single force. Mr. Redfield's hypothesis, which is sufficiently indefinite and general to include all the rest, was anticipated by Galileo, who attributed the ocean tides "to the rotation of the earth, combined with its revolution about the sun." It appears that Galileo's opinion attracted little attention and led to no special investigation, partly, perhaps, because it was difficult to reconcile it with the tidal intervals, and partly because a literal as well as figurative reasoning in a circle apparently demonstrated that the motions in question could produce no disturbing force. I will endeavor to point out the fallacy of this conclusion by deducing, from a reference of the aerial motions to a supposed stationary earth, a law of tidal variation nearly identical with the law that is derived from a consideration of the relative attractions of two bodies revolving about their common centre of gravity.

On account of the combined effects of the earth's rotation and revolution, each particle of air has a velocity in the direction of its orbit, varying at the equator from about 65,000 miles per hour, at noon, to 67,000 miles per hour at midnight. The force of rotation may be readily compared with that of gravity by observing the effects produced by each in twenty-four hours, the interval that elapses between two successive returns of any point to the same relative position with the sun. The force of rotation producing a daily motion of 24,895 miles, and the force of terrestrial gravity a motion of 22,738,900 miles, the ratio of the former to the latter is $\frac{24895}{22738900}$, or ·00109. This ratio represents the proportionate elevation or depression of the barometer above or below its mean height, that should be caused by the earth's rotation, and it corresponds very nearly with the actual disturbance at stations near the equator.

From 0h. to 6h. the air has a forward motion greater than that of the earth, so that it tends to fly away; its pressure is therefore diminished, and the mercury falls. From 6h. to 12h. the earth's

motion is greatest; it therefore presses against the lagging air, and the barometer rises. From 12h. to 18h. the earth moves away from the air, and the barometer falls; while from 18h. to 24h. the increasing velocity of the air urges it against the earth, and the barometer rises.

If the force of rotation at each instant be resolved into two components, one in the direction of the radius vector, and the other parallel to the earth's orbit, it will be readily perceived that whenever the latter tends to increase the aerial pressure, the former tends to diminish it, and *vice versa*. Let B = the height of the barometer at any given instant; M = the mean height at the place of observation; θ—90° = the hour angle; C = the earth's circumference at the equator; t = 24 hours; g = the terrestrial gravity; l = the latitude; and a simple integration gives the theoretical formula,

$$\mathrm{B} = \mathrm{M}\left(1 + \frac{\sin.\ \theta.\ \cos.\ \theta.\ \cos.\ l}{\mathrm{R}^3} \cdot \frac{2\mathrm{C}}{gt^2}\right).*$$

This formula gives a maximum height at 9h. and 21h., and a minimum at 3h. and 15h. The St. Helena observations place the maximum at 10h. and 22h., and the minimum at 4h. and 16h., an hour later in each instance than the theoretical time. This is the precise amount of retardation caused by the inertia of the mercury, as indicated by the comparisons with the water barometer of the Royal Society of London.

Aerial currents, variations of temperature, moisture, and centrifugal force, solar and lunar attraction, the obliquity of the ecliptic, and various other disturbing causes, produce, as might be naturally expected, great differences between the results of theory and observation. But, by taking the grand mean of a series of observations, sufficiently extended to balance and eliminate the principal opposing inequalities, the two results present a wonderful coincidence.

According to our formula, the differences of altitude at 1, 2, and 3 hours from the mean, should be in the respective ratios of ·5 ·866, and 1. The actual differences, according to the mean of the St. Helena observations, are as follows:

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* $\frac{\mathrm{C}}{gt^2}$ represents the effective ratio of an entire day. But there is in each day a half day of acceleration, and a half day of retardation, and the ratio for each half day is $\frac{\mathrm{C}}{2} \div \frac{gt^2}{4} = \frac{2\mathrm{C}}{gt^2}$.

Differences of Barometer.				Ratios.		
Difference of time.	1h.	2h.	3h.	1h.	2h.	3h.
Before 1h. -	·0166	·0298	·0365	·455	·816	1
After 1h. -	·0159	·0266	·0298	·534	·893	1
Before 7h. -	·0122	·0202	·0243	·502	·831	1
After 7h. -	·0135	·0239	·0297	·455	·805	1
Before 13h. -	·0136	·0248	·0284	·479	·873	1
After 13h. -	·0131	·0215	·0227	·577	·947	1
Before 19h. -	·0161	·0287	·0348	·463	·825	1
After 19h. -	·0150	·0265	·0286	·524	·927	1
Mean, -	·0145	·0252	·0293	·495	·860	1

The mean of the above differences varies from the theoretical mean, less than $\frac{1}{5000}$ of an inch. If we take the mean of the ratios, instead of the ratios of the means of the observed differences, the coincidence is still more striking.

Difference of Time,	1h.	2h.	3h.
Means of observed Ratios,	·498625	·864625	1·000000
Theoretical Means,	·500000	·866025	1·000000

The calculated time for the above observed means, differs less than 20″ from the actual time.

Observed Means,	·498625	·864625	1·000000
Theoret. Difference of Time,	59′ 48″	119′ 40″	180′
Observed Difference of Time,	60′ 0″	120′ 0″	180′

The varying centrifugal force to which the earth is subjected by the ellipticity of its orbit, must, in like manner, produce annual tides. The disturbing elements render it impossible to determine the average monthly height of the barometer with any degree of accuracy, from any observations that have hitherto been made. We may, however, make an interesting approximation to the annual range, still using the St. Helena records, which are the most complete that have yet been published for any station near the equator. Comparing the mean daily range, as determined by the average of the observations at each hour, with the mean yearly range, as determined by the monthly averages, we obtain the following results :

Year.	Daily Range.	Annual Range.	Ratio.	Approximate Solar Distance.
1844	·0672 in.	·1650 in.	2·4553	137,070,000 m.
1845	·0646 in.	·1214 in.	1·8793	80,300,000 m.
1846	·0670 in.	·1214 in.	1·8120	74,650,000 m.
	3)·1988	3)·4078	3)6·1466	
	·0663	·1359	2·0489	95,446,000 m.
Mean,	·0663	·1290	1·9457	86,056,000 m.
	2)·1326	2)·2649	2)3·9946	
	·0663	·1324	1·9973	90,702,000 m.

The approximate estimates of the solar distance are based on the following hypothesis:

Let e = effective ratio of daily rotation to gravity.

a = arc described by force of rotation in a given time t.

r = radius of relative sphere of attraction, or distance through which a body would fall by gravity, during the disturbance of its equilibrium by rotation.

A = area described by radius vector in time t.

Let e', a', r', A$'$, represent corresponding elements of the annual revolution. Then,

$$A : A' :: ar : a'r' :: e^2 : e'^2$$

But the forces of rotation and revolution are so connected, that a differs but slightly from a'

$$\therefore \left.\begin{array}{c} e^2 : e'^2 :: r : r' \\ r' = \dfrac{e'^2 r}{e^2} \end{array}\right\} \text{very nearly.}$$

It may be interesting to observe how nearly r (22,738,900 m.) corresponds with Kirkwood's value of $\frac{D}{2}$ (24,932,000 m.). A more thorough comprehension of all the various effects of gravity and rotation on the atmosphere, would probably lead to modifications of our formulæ that would show a still closer correspondence.

There is a great discrepancy between the determinations of the solar distance that are based on the records of 1844 and 1846; but it is no greater than we might reasonably have anticipated. On the other hand, it could hardly have been expected that any comparisons based on the observations of so short a period as three years, would have furnished so near an approximation to the most recent and most accurate determination of the earth's mean radius vector. In

order to obtain that approximation, it will be seen that I took, 1st, the mean of the ranges and ratios for the three successive years; 2d, the ranges and ratios of the mean results of the three years; 3d, the grand mean of these two primary means. I could think of no other method which would be so likely to destroy the effects of changing seasons and other accidental disturbances.

The following table exhibits the effects of latitude on the aerobaric tides. The differences between the theoretical and observed ranges may be owing partly to the equatorial-polar currents, and partly to insufficient observations:

Station.	Lat.	Mean Height.	Mean Range.	Ratio.	Theoret. Ratio.
Arctic Ocean,	78° 37′	29·739 in.	·012 in.	·000404	·000527
Girard College,	39 58	29·938	·060	·002004	·002046
Washington,	38 53	30·020	·062	·002065	·002079
St. Helena,	15 57	28·282	·066	·002344	·002567
Equator,	0	30·709	·082	·002670	·002670

The theoretical ratios are determined by multiplying the equatorial ratios by $\frac{\cos l}{R}$. The formula, $\rho = \frac{\cos l}{R} \cdot \frac{2c}{gt^2}$, ($\rho$ indicating the ratio of the mean range to the mean height), gives

		Theoretical Ratio.	Observed Ratio.
Latitude,	0°	·002190	·002670
Latitude,	78 37′	·000432	·000404

showing that the ratio is less near the pole and greater near the equator than our theory indicates, a natural consequence of the centrifugal force at the equator and the cold surface currents that produce the trade winds.

The revolution of the sun around the great Central Sun must also cause barometric fluctuations that may possibly be measured by delicate instruments and long and patient observation. The Torricellian column may thus become a valuable auxiliary in verifying or rectifying our estimates of the distances and masses of the principal heavenly bodies.

Dr. Wood, requesting Prof. Cresson to take the Chair, described the peculiarities of the growth of the olive tree in Spain and its method of cultivation, reading from his journal an interesting account of his tour through the olive-planting districts.

Mr. Durand then obtained permission to read an obituary notice of the late Dr. Short, of Louisville, prepared by Dr. Gray, of Cambridge, Mass. Mr. Durand stated that the admirable Herbarium of Dr. Short would be deposited in the Academy of Natural Sciences in Philadelphia. On motion of Mr. Durand, Dr. Gray was appointed to prepare an obituary notice of the late Dr. Short, for this Society.

The Finance Committee presented their annual report, and recommended the following appropriations to be made for the coming year, which on motion was accordingly done, viz.:

Journals,	$50
Hall,	600
Binding,	100
Publication,	800
Salary of Librarian,	700
Salary of Assistant,	360
Salary of Janitor,	100
Petty expenses of Library,	50
Insurance,	200
General expenses,	500
	$3,460

New nominations Nos. 506, 507, were read.

And the Society was adjourned.

Stated Meeting, January 1, 1864.

Present, seventeen members.

The judges and clerks of the annual election held this day, reported the following officers as duly elected:

President.

George B. Wood.

Vice-Presidents.

John C. Cresson,
Isaac Lea,
George Sharswood.

Secretaries.

Charles B. Trego,
E. Otis Kendall,
John L. Le Conte,
J. Peter Lesley.

Curators.

Franklin Peale,
Elias Durand,
Joseph Carson.

Members of the Council for Three Years.

Alfred L. Elwyn,
John Bell,
Henry Coppée,
Oswald Thompson.

Treasurer.

Charles B. Trego.

Photographic portraits of Dr. Hyrtl and Dr. Rokitansky, of Vienna, and of Dr. D. Francis Condie, of Philadelphia, were presented to the Society.

Donations for the Library were received from the Royal

Astronomical Society, the Essex Institute, the Franklin Institute, Dr. Roehrig, and Prof. A. D. Bache.

The death of Lewis Waln, a member of the Society, on the 20th ult., aged 68, was announced by Prof. Trego, and Prof. Cresson was appointed to prepare an obituary notice of the deceased.

Mr. Chase made a communication, in relation to the height of the tides, as connected with atmospherical phenomena, and the diurnal and annual motions of the earth.

The following table furnishes material for many instructive comparisons, some of which deserve special notice on account of the additional confirmations that they furnish to the rotation theory. The column headed "Observed Height of Barometer," gives the grand mean of three years' observations at St. Helena: A represents the theoretical height as computed by our formula; B introduces such modifications as would result from assuming the mean of the equatorial observations as a normal equatorial altitule.

TABLE OF MEAN BAROMETRICAL RESULTS, THEORETICAL AND OBSERVED.

Time.	Ratio of observed heights.	Observed height of bar 28 in. +	Theoret. height A 28 in. +	Error A.	Theoret. height B 28 in. +	Error B.	Diff. of Errors.
0 h	1·00060	·2985	·2970	—15	·3002	17	—32
1	1·00000	·2819	·2821	2	·2821	2	0
2	·99945	·2660	·2672	12	·2640	—20	32
3	·99905	·2553	·2563	10	·2507	—46	56
4	·99894	·2521	·2523	2	·2458	—63	65
5	·99908	·2562	·2563	1	·2507	—55	56
6	·99938	·2642	·2672	30	·2640	— 2	32
7	·99982	·2764	·2821	57	·2821	57	0
8	1·00028	·2899	·2970	71	·3002	103	—32
9	1·00065	·3003	·3079	76	·3135	132	—56
10	1·00086	·3061	·3119	58	·3184	123	—65
11	1·00074	·3025	·3079	54	·3135	110	—56
12	1·00033	·2913	·2970	57	·3002	89	—32
13	·99988	·2777	·2821	44	·2821	44	0
14	·99938	·2646	·2672	26	·2640	— 6	32
15	·99908	·2562	·2563	1	·2507	—55	56
16	·99905	·2550	·2523	—27	·2458	—92	65
17	·99926	·2611	·2563	—48	·2507	—104	56
18	·99973	·2737	·2672	—65	·2640	—97	32
19	1·00028	·2898	·2821	—77	·2821	—77	0
20	1·00081	·3048	·2970	—78	·3002	—46	—32
21	1·00120	·3163	·3079	—84	·3135	—28	—56
22	1·00130	·3184	·3119	—65	·3184	0	—65
23	1·00107	·3117	·3079	—38	·3135	18	—56

It will be seen that the purely theoretical height A corresponds more nearly with the observations than the mixed height B. It is therefore evident that there is a slight disturbance (which may perhaps be owing either to variations of temperature, or to a resisting medium), which follows a different law from the principal disturbance.

The changes are least near the times of high and low tide, and greatest midway between the two tides. If we compare the average high and low tides, we see that the observed height is somewhat less at high tide, and somewhat greater at low tide, than theory would give. These results would naturally follow from the combined fluidity and gravitation of the air.

From 1h. to 15h. inclusive (during most of which time the radius vector of each particle of air is increasing), the observed height of the barometer is less than the theoretical height.

From 16h. to 0h. inclusive (radius vector diminishing), the observed height is greater than the theoretical height.

The greater pressure before noon than before midnight, is precisely the result which would follow from the passage of the earth through a resisting medium, but it is directly opposed to the supposed tendencies of varying temperature.

The apparent difference in the laws that govern the aerial and ocean tides may be partially, if not wholly, accounted for by considering the difference of constitution in the two media, and the relative positions of the observer. The air is highly elastic and compressible, while water is cohesive and incompressible; the observer is placed underneath the atmosphere, but above the ocean. The air can therefore readily yield to any expanding or condensing force, without much perceptible motion, while a similar force applied to water would produce motion in the direction of least resistance; any force that tends to throw fluids away from any given portion of the earth, produces a high aerial tide, but a low barometric tide, and after some interval a high oceanic tide.

The frequent coincidence of high water with a low barometer, has been noticed by many observers, and it is strikingly presented in the comparative drawings given by Lubbock, in his Theory of the Tides. The prompt effect of rotation, combined with the retardation of the cumulative action which produces the lunar tides, may perhaps account for the errors of theory in Lubbock's Table of the

SEMI-MENSTRUAL INEQUALITY AT LONDON.

Apparent solar time of moon's transit B.		HEIGHT.		
		Theory.	Observation.	Error.
h.	m.	feet.	feet.	feet.
0	30	22·72	22·72	0
1	30	22·54	22·44	+·10
2	30	22·07	21·92	+·15
3	30	21·36	21·14	+·22
4	30	20 55	20·23	+·32
5	30	19·83	19·57	+·26
6	30	19·56	19·55	+·01
7	30	19·93	20·26	—·33
8	30	20 69	21·15	—·46
9	30	21·49	21·89	—·40
10	30	22·16	22·42	—·26
11	30	22·59	22·70	—·11

The regular recurrence of the aerial tides at stated hours, is a sufficient evidence of their dependence upon the relative positions of the earth and sun. Though the differential effect of the moon's attraction is greater than that of the sun's, the intensity of the solar attraction is much the greater. I am inclined to believe that this intensity is manifested in a greater stability of the solar attraction-spheroid, which prevents its yielding readily to the effects of rotation.

Lubbock quotes from Williams's Narrative of Missionary Enterprises, p. 172, his remarks on the "well-known fact that the tides in Tahiti and the Society Islands are uniform throughout the year, both as to the time of the ebb and flow, and the height of the rise and fall; it being high water invariably at noon and midnight, and low water at six in the morning and evening. The total range from low to high water seldom exceeds eighteen inches or two feet." The earth's rotation, producing an alternate half-day's acceleration and retardation in the eastward motion of the water, should create a tendency to tides of this character, and the situation of the islands mentioned, is peculiarly favorable for the development of that tendency. Were they near a continent or at the entrance of a gradually narrowing ocean, they would feel the influence of the derivative tide which accumulates the attractive energies of the moon for several successive transits, and the tides would vary with the moon, as upon our own shores: but the nearly uninterrupted ocean sweep of 80° to the eastward may give the combined rotation and solar waves such resistless force, that they can easily overcome the weak intensity

of the lunar attraction. If this hypothesis is confirmed by more accurate observations, the theory of Galileo will not only help us in our explanations of the aerial tides, but it will also lead to the recognition of a most important element in the ocean tides.

Prof. Coppée suggested that the subject of the "Danish Element in England," was worthy of the attention of the Society, describing the traces, still obvious, of the original Celtic and Teutonic occupation of the island. Dr. Washburne spoke of the northern English types, as existing in New England, and were deserving of farther study. Dr. Coates referred to the translation, by early emigrants, of old english names of places to the new localities in New England, which the emigrants occupied; and made further observations upon the origin of human races. Mr. Chase referred to the alleged early settlement of America by the Northmen.

Professor Lesley was nominated Librarian for the ensuing year.

Pending nominations Nos. 506, 507, were read.

And the Society was adjourned.

Stated Meeting, January 15, 1864.

Present, eighteen members.

Dr. Wood, President, in the Chair.

A letter accepting membership was received from Dr. Theodore Schwann, of Liège.

A communication from Mr. H. Stephens, of London, was read, proposing to act as general book agent, in Europe.

Donations for the Library were received from Prof. Zantedeschi, the Hon. J. D. Baldwin, Messrs. Blanchard & Lea, and Mr. C. H. Hart.

Dr. Emerson communicated the following fact, respecting the propagation of atmospheric vibrations to great distances.

He was at a place in the State of Delaware, on the night of the great explosion at Yorktown, Va., and one hundred and fifty miles distant from that city. The windows of his house were shaken in so remarkable a manner, that he could assign no other cause, but that of the explosion of the Yorktown powder magazines. Prof. Cresson mentioned an instance of a similar nature, which had come under his own observation, and, apparently, confirming Dr. Emerson's views.

Mr. Price read part of a paper entitled, "The Family, as an Element of Government."

THE FAMILY AS AN ELEMENT OF GOVERNMENT.

"God setteth the solitary in families."—Psalm 68 : 6.

It is with hesitation and misgiving that I bring this subject before you; fearing to detain your attention too long, and apprehensive that it may not be thought strictly appropriate for our discussion. That the subject most nearly relates to man and his well-being, and is to disclose the design of the Creator in regard to him, should not make it the less one, it seems to me, of philosophical inquiry and interest. And if from the physical we should rise, in our investigations, to the moral and social welfare of man, still the subject will retain all its philosophical fitness, and deserve our attention. Permit me, then, to confess at the outset that I cherish the design to do a moral good, in my limited ability, and the better to do it, I wish to borrow your prestige. I have thought that if you would listen with approbation, others will think it worth while to read, and that ideas deemed salutary to society, though familiar to you, may thus more favorably reach those to whom they are less known. I cannot promise you novelty, for in constantly observed human nature, law, and morals, there is not so much opportunity to discover anything new, as there is a duty to insist upon what is already known for our good; and as law and morals have for their object but to state and impress a sound rule of conduct in life, sound practical sense is the highest merit that a writer upon these subjects can hope to attain.

I am conscious of addressing some, who, as naturalists, are accustomed to study the nature and habits of living creatures lower in the scale of beings than man. These are studied with a laborious care, minuteness, and skill, and an exactness of classification, that is absolutely surprising to others who are differently occupied. And for

what is all this self-sacrificing patience of intellectual labor? Chiefly but to gratify a scientific curiosity, and to penetrate into the intents and wisdom of the Creator, as displayed in his works. It is but to elevate and advance our views in the same course of study, to consider man in his domestic, social, and political relations; but with this higher interest, that it is to study our own nature and highest welfare.

It is when legislation grows out of human wants, and accords most closely with nature, that it is most useful and enduring. We begin, therefore, at the right point, when we study the nature and needs of man, with purpose to legislate for his welfare. I propose, in this discourse, that we shall consider the human family, that we may duly estimate its importance as an element of government, and consider how much it should be favored by our personal influences, by judicial decision, by legislation, and in all our social regulations.

To sketch the history and formation of the family, is to go back to the origin of all society, and see it in its inception. "Male and female," God created the first parents; and these becoming the parents of children, the family is formed and bound together by ties inherent in our nature, and the strongest in nature. These partake of the character of an instinct, but are more than the instinct that rules inferior beings, for the parental and filial affections endure beyond any physical necessity, and end only with life, and not then without the earnest hope and passionate desire of the family reunion.

As the family increases, and the descendants multiply and marry, and again increase, the grandfather becomes the patriarch of a tribe. Tribes grow to be a people. In the lowest stage of society they live by hunting, fishing, and upon the spontaneous fruits of the earth; thence rise to be shepherds, and to feed their flocks, move from place to place. In pursuit of game and pasturage they come into contact, and contesting for the territory that yields the needed supplies, they make war, and the men become warriors, and then the chief burden is cast upon women to support the family. The American Indians, when found in the north, were in this hunter state; Abraham and Lot were in the pastoral stage; and the Germans, in the time of Cæsar and Tacitus, were in the same stage, only cultivating the soil where the nation rested for a season, without any permanent division or ownership in it. In this condition families followed their military leaders; and as war was the principal business of each people, there was but slight development of the family institution, as we see it in civilized society. The separate home, with its sacred seclusion, ex-

cept as the door is opened by hospitality, was yet wanting to the civilization and happiness of mankind.

The earliest known occupation of our ancestral communities of Northern Europe, was that of shifting masses, moving forward as they had the desire and the strength, regardless of the rights of neighboring communities, except as the latter had power, for a time, to resist the ever onward pressure westward and southward. When these moving masses began to appropriate the soil, and to settle in fixed localities, it was under the feudal system, by which lands were temporarily allotted to military followers, upon condition of rendering military service, or needed supplies in kind. Hence titles came to be held upon tenures which only expired in our revolution. This degree of settlement ripened into greater certainty and duration of title, and the commutation of rents for military services. Villages and towns were built, but at first only at the base of hills, crowned by the castle of the military chieftain, who was their needed protector, as the inhabitants were his necessary retainers. Centuries passed before life and property became so secure as to admit of sparse habitations over the face of the country; and at this moment all Europe retains the features formed by the insecurity of the middle and prior ages of its history. There everywhere are yet seen the heights crowned by often crumbling castles, with the village or town beneath, while wide and distant tracts are cultivated, in small subdivisions, by villagers who each night return to their village homes.

As the arts advanced and towns grew into importance, and the military lords borrowed of the rich burghers, or sold them lands to obtain money to enter upon the crusade to Jerusalem, and commercial cities arose under royal charters, and formed leagues against the chiefs who had levied tribute on travellers and trade, a greater dependence was placed upon the central government or crown, and the people gradually became disenthralled of the local military despotisms. With a general government of law pervading a national territory, came security to families, and thence arose the modern civilization of Europe and America, the highest and most intelligent the world has yet known. In ancient Jerusalem, and Athens, and Rome, a high civilization and refinement had indeed been known, but that refinement became steeped in corruption; for the world had not then known the true source of the highest refinement of human manners; and when Christianity first spread over Southern Europe, while yet under Roman rule, it was slow to produce its legitimate effects, by reason of the previous deep corruption; so deep, indeed, that it could

only be cured by a fresh infusion of barbarian vigor, and the eradication of degenerate men. But the infusion of Huns, Goths, and Vandals, were rough materials for Christianity to mould into civilization.

Though rude and warlike, these invading hordes from the great Northern hive supplied the needed elements for the renovation of the corrupt descendants, now the fragments of the Roman Empire. These conquerors of the Empire became themselves captives to the Christianity of the conquered; and that faith, a milder climate, and the more refined manners of the South, had their natural civilizing influences upon the new settlers in Southern Europe and Northern Africa. These brought not only their fresh and uncorrupted natures from the forests of Germany, but they also brought with them a characteristic peculiar to themselves, worth more than all the civilized effeminacy they displaced,—they brought with them a profound reverence for woman. Let us remember this, for it is the element of the world's highest civilization, next to Christianity, for nearly two thousand years, and is to co-operate with that faith in the indefinite future.

Of their earliest written history Tacitus gives the best account, and in this wise speaks of the sentiment of the ancient German mind towards their women, in whose presence they fought their battles, with the dreadful alternative that defeat would destine wives and daughters to the horrors of slavery: "There is, in their opinion, something sacred in the female sex, and even the power of foreseeing future events. Their advice is, therefore, always heard; they are frequently consulted, and their responses are deemed oracular. We have seen in the reign of Vespasian, the famous Veleda revered as a divinity by her countrymen. Before her time, Aurinia and others were held in equal veneration; but a veneration founded on sentiment and superstition, free from that servile adulation which pretends to people heaven with human deities." (Sec. viii.) Tacitus further says, " Marriage is considered as a strict and sacred institution. In the national character there is nothing so truly commendable. To be contented with one wife is peculiar to the Germans. They differ in this respect from all savage nations." (xviii.) "In consequence of these manners, the marriage state is a life of affection and female constancy. The virtue of the woman is guarded from seduction. No public spectacles to seduce her; no banquets to inflame her passions; no baits of pleasure to disarm her virtue." Her

very infrequent infidelity to the marriage vow was instantly visited by ignominious punishment, and unpardonable dishonor. (xix.)

This praise of the philosophical historian and censor of Roman morals, is given in manner to point the contrast with the corrupt manners of his own country. He had witnessed the effects of the vices that had largely brought marriage into disuse, at a period when Rome had been greatly depopulated by foreign and domestic wars; an evil which Augustus had sought to remedy by bringing marriages into credit by rewards and privileges, and celibacy into discredit by disfavor and penalties; and the censures of Tacitus stand in accord with those of Horace, and Juvenal, and St. Paul. In Asia the condition of woman was that of constrained seclusion; and, where not under restraint in Southern Europe, she enjoyed to abuse her liberty; led to do so by he who should have been the protector of her virtue. It was only when Christianity met the uncorrupted manners and better natural character of the uncivilized German nations, that came together the fitting elements needed to reconcile the European freedom of woman with her inviolate purity; and to make woman and the family instruments of the world's most perfect civilization and happiness. Yet we must never forget that Rome in her better days had her Lucretia, Cornelia, Portia, and even in evil times had her Agrippina, Arria, Cæcina, Fannia, Sophronia, Valeria, Paulina. Even then woman had the glory of resisting the tide of corruption, as she soon after had the glory of martyrdom in the establishment of the Christian faith, that was to do more than restore her to her former virtue and influential position.

Greece, the most cultivated of ancient nations, placed woman in a higher position than the Asiatics, yet placed her not so high as we see her, as the trusted counsellor and friend of her husband, as well as influential matron of the household. "The wife is housewife and nothing more," says Heeren. "Even the sublime Andromache, after that parting which will draw tears as long as there are eyes which can weep and hearts which can feel, is sent back to the apartments of the women, to superintend the labors of the maid-servants." "We meet with no trace of those elevated feelings, that romantic love, as it is very improperly termed, which results from a higher regard for the female sex. That love and that regard are traits peculiar to the Germanic nations, a result of the spirit of gallantry, but which we vainly look for in Greece. Yet here the Greeks stand between the East and the West. Although he was never to revere the female sex as beings of a higher order, he did not, like the Asiatic, imprison them by troops in a harem." (Heeren's Greece, 95.)

In speaking of peoples having a Germanic origin, those of England and Gaul are included, for these countries, before, as we know after their historic ages, had no doubt received accessions, or suffered conquests from the north of Germany, called the "womb of nations." Tacitus conjectured the Britons to have come from the neighboring continent. "You will find," he says, "in both nations the same religious rites, and the same superstition. The two languages differ but little;" he says, speaking of the Britons and the Gauls. (Life of Agricola, lxi.) After the Roman armies had been withdrawn, and the Picts and Scots made inroads, the Saxons, including the Engles, who gave name to England, were called in from the north of Germany; to whom succeeded the Danes, and afterwards the Normans, all of whom sprang from the same prolific source. Normans, though last from Normandy, meant Northmen; as Germans meant *gere*-men, or warmen; a generic name that described, by their most striking characteristic, the many peoples of Germany, who, under various names, bore down upon every country of Western and Southern Europe.

The Germans had no doubt a previous Eastern origin, since philology and other traces indicate that the stream of population had flowed from Central Asia, the real source of the German nations. Whatever had been their original condition, the masses moved westward, as hunting, pastoral, and warlike nations; conditions incompatible with the jealous seclusion of women, which has always characterized Southern Asia. Under the necessity of sharing the toils, hardships and dangers of husbands, fathers, and sons, who passed all of life in moving camps, seclusion and effeminacy were not the traits either of the sons of Tuisto or Odin, or of the daughters of Freya. Exposed to common dangers, and liable to be separated from husband and children by the fate of battle, and to become the slaves of the conquerors, a fate more terrible than death, their anxieties quickened their perceptions and foresight, and they became, beyond their husbands, thoughtful, astute, prophetic of the future; became their assistants in battle, the nurses of the wounded, the providers for the family; man's truest friend and counsellor. Life then was nearly a constant warfare; the soil was without fixed ownership; was sparsely appropriated, but while the crop of the season should mature and be gathered. By the law that sprang from their profound reverence for woman and the marriage relation, the husband was allowed no second wife to share with her his affections; nor was she permitted to take a second husband even after his death. Under this stern

abstemiousness, so different from the husband of Asiatic habits, or of Roman customs and manners, with their shocking facilities of divorce, the trusted and faithful wife held a most influential place in the family, as well as became a counsellor in public affairs. Hither, then, and to this rude age, it is believed, we may mainly trace the origin of that different treatment of women which has distinguished Northern and Western Europe, during all her historic period, from all the rest of the world, and which has largely contributed to place that smallest of the four continents in the front rank of the world's civilization; a sentiment and treatment which must continue to influence the world while the human race shall last.

It could not be otherwise than that woman should have attained to an exalted influence among the ancient inhabitants of Germany, when we further read from Tacitus how closely her fate was allied to her husband's and what was her participation in his achievements. "They fight in clans, he says, united by consanguinity, a family of warriors. Their tenderest pledges are near them in the field. In the heat of the engagement, the soldier hears the shrieks of his wife and the cries of his children. These are the darling witnesses of his conduct, the applauders of his valor, at once beloved and valued. The wounded seek their mothers and their wives. Undismayed at the sight, the women count each honorable scar, and suck the gushing blood. They are even hardy enough to mix with the combatants, administering refreshment, and exhorting them to deeds of valor. From tradition they have a variety of instances of armies put to the rout by the interposition of their wives and daughters again incited to renew the charge. Their women saw the ranks give way, and rushing forward in the instant, by the vehemence of their cries and supplication, by opposing their breasts to danger, and by representing the horrors of slavery, restored the order of battle. To a German mind the idea of a woman led into captivity is insupportable. In consequence of this prevailing sentiment, the states which deliver as hostages the daughters of illustrious families, are bound by the most effectual obligation." (Manners of the Germans, vii, viii.)

When the migratory nations in and from Germany, became fixed to localities by an appropriation of the soil and its use in agriculture, under the feudal system, and subject to its military services, which in England were only terminated by statute in 1660, the condition of private families became the more secure, and more subject to the meliorating influences of the mother, wife, and sister, so long as they

were held in respect and honor; and that they should be so held, there were the concurring causes of marriage to one wife, the inherited reverence for the sex, and the power of the Christian faith. This sentiment of loyalty to woman was the light and the life of the nations through the dark ages; and when ignorant and brutal men, in the security of their feudal castles, became the tyrants and oppressors of men and women, that sentiment was relumed with yet greater brightness, and produced the ages of chivalry. Then brave and thoughtful and humane men counted it their highest happiness and honor to relieve oppressed innocence in the championship of the honored sex. An enthusiastic sentiment, kindred to religious devotion, filled the breasts of the orders of knighthood; and woman was loved not only for what she was, but in the highest ideal that the enkindled imaginations of men could form of her excellence; and men and women were alike elevated in purity and character, as they truly cherished these exalted sentiments. The transition was easy and natural, and the chivalry of Europe became the crusaders of the East; then rejoicing both in a devotion to the ideal of woman's excellence and to the Cross of Christ. The Council of Clermont, which in 1095 authorized the first Crusade, formally recognized chivalry by declaring, "that every person of noble birth, on attaining twelve years of age, should take a solemn oath before the bishop of his diocese, to defend to the uttermost the oppressed, the widows and orphans; that women of noble birth, both married and single, should enjoy his special care; and that nothing should be wanting in him to render travelling safe, and to destroy the evils of tyranny." Thus did the church and religion lend their holy sanction to the high sentiment of humanity that gave life to chivalry. Yet observe, that oath was limited in its special application to "women of noble birth!" Better this than none; yet how narrow it seems in this age, and in a Christian republic.

How much better the sentiment I once heard from a Swedish artisan, who gave up his seat in the coach to take one on the top in the rain, to accommodate a plain woman who applied for a passage: "I always remember that my mother was a woman!"

Hallam, who thoroughly surveyed the history of the Middle Ages, says, "I am not sure that we could trace very minutely the condition of women for the period between the subversion of the Roman Empire and the first Crusade; but apparently man did not grossly abuse his superiority; and in point of civil rights, and even as to the inheri-

tance of property, the two sexes were placed as nearly on a level as the nature of such warlike societies would admit." (Middle Ages, 329.) It was a necessity of the military services to be rendered under the feudal system, that the eldest son should be preferred to the inheritance of lands held by military tenure. Hallam acknowledges that "A great respect for the female sex had always been a remarkable characteristic of the Northern nations. The German women were high-spirited and virtuous; qualities which might be causes or consequences of the veneration with which they were regarded." He should have said these qualities were both causes and consequences of that veneration. He speaks of the spirit of gallantry, cherished as the animating principle of chivalry, as due to the progressive refinement of society in the twelfth century, and he might also have acknowledged it a cause to produce that refinement; for by action and reaction, causes and effects for good or for evil, are of perpetual reciprocal operation; and hence the greater encouragement ever to strive for the good, since effects ever become causes in a ceaseless concatenation. Can we say less, when this our age rejoices in the beneficent effects of a sentiment that pervaded the breasts of our rude ancestors, two thousand years ago, in the forests of Germany? a sentiment then peculiar to them, and destined to become yet brighter in their descendants, and to illumine more widely the world, if men and women will but conceive and practise the highest excellence of which they are capable.

It is in Heeren's philosophical reflections upon Greece, that we find the truest expression of the source of European superiority over all other nations, howsoever much we may differ or agree as to the effect of climate or physical causes.

Similarity of climate does traverse the circumferences of the globe, in all its different latitudes, though the same degree of temperature follows waving geographical lines; yet the habits and manners of every people are diversified in degrees, much beyond all that can justly be ascribed to the single cause of the presence of heat or cold, clouds or sunshine; and immeasurably beyond the single cause of climate do the civilization, intelligence and power of the Europeans and their American descendants surpass those of all other nations. And, if all the causes of that difference be examined and considered, it is believed that no single one, other than religion, can justly claim an equal influence over the formation of character with that which results from the European family, and woman's power in the family, as there and here constituted.

After adverting to the physical causes of climate, soil, and geographical configuration, and the disadvantages of being yet in the shepherd state of the Tartars and Mongolians, among unsubdued forests, Heeren proceeds to ask, "But, can we derive from this physical difference, those moral advantages which were produced by the better regulation of domestic society? With this begins, in some measure, the history of the first culture of our continent. Tradition has not forgotten to inform us that Cecrops, when he founded his colonies among the savage inhabitants of Attica, instituted at the same time regular marriages; and who has not learned of Tacitus, the holy custom of our German ancestors? Is it merely the character of the climate which causes both sexes to ripen more gradually, and, at the same time more nearly simultaneously, and a cooler blood to flow in the veins of man; or, has a more delicate sentiment impressed upon the European a higher moral nobility, which determines the relations of the two sexes? Be this as it may, who does not perceive the decisive importance of the fact? Does not the wall of division which separates the inhabitants of the East from those of the West repose chiefly on this basis? And can it be doubted that this better domestic institution was essential to the progress of our political institutions? For, we make with confidence the remark, no nation where polygamy was established has ever obtained a free and well-ordered constitution. Whether these causes alone, or whether others beside them (for, who will deny that there may have been others?) procured for the Europeans their superiority, thus much is certain, that all Europe may now boast of this superiority. If the nations of the South preceded those of the North; if these were still wandering in their forests when those already had obtained their ripeness, they finally made up for their dilatoriness. Their time also came; the time when they could look down upon their Southern brethren with a just consciousness of superiority." (Heeren's Greece, 8.)

It is believed that such philosophers as Buckle are quite too limited in their conceptions, when they ascribe to material causes all the differences of national character. These have truly modifying influences; but human sentiments, thoughts, traditions, law, song, religion, may have yet greater effect to form the character of nations; that is, moral, mental, and religious causes may be more potential than the differences of the physical causes pervading the world.

The first inhabitants of Northern Germany, while in their pastoral state, could not have been influenced by physical causes essentially different from those which influenced their Mongolian relatives in

Asia; the elevated table land of the latter giving them the lower temperature that belongs to a higher latitude on the western side of that hemisphere. That is, as we go westward, we go further northward to keep in the same temperature, at the same elevation. The climate being similar, and the mode of life the same, the religion of both derived from the Indian mythology, and woman, necessarily the exposed companion of man, while both pursued a nomadic life, living in temporary huts, the physical causes operating upon the kindred people of Asia and Europe, under the same temperature, could be little different. Nothing can be pointed to as cause for the extraordinary disparity of results, except a different religion during later centuries, so significant as the German's high respect for woman, with a single wife and mother in his family; while his ancestral nations in Asia had no such exalted sentiment, or lost it, and continued to live in polygamy, with a liberty to divorce their wives at pleasure: causes heightened in effect by the acceptance of Christianity in Germany, and of Budhism, as the religion of Central Asia. From the rude and warlike Goths, Vandals, Huns, Lombards, Saxons, all parts of Europe have attained the highest and most intelligent civilization known to the world, while the Mongolians and Tartars have made no considerable advances in civilization since written history has furnished her narratives. It is true, a milder climate and the intermingling with civilized peoples in the south, helped the process of amelioration; but these causes could not operate in countries bordering on the Baltic and the German Ocean, which had no influx of people from the south; where yet may be traced a profounder respect for woman, and a more vigorous manhood than in the south of Europe.

The sentiment of devotion to the sex ran highest in its profession in the ages of chivalry and romance. But this was not the wholesome and practical condition of society, which we should recommend as best adapted for woman's true welfare and the true interest of society. Tournaments and courtly assemblages of the nobility were not the best school of her training. All that glittered so brightly, was not truthfully of intrinsic purity and value. Virtue is not best preserved where a prince and nobility enjoy by law, or privilege, or opinion, an immunity from the common responsibilities of men. Kings, who legally could do no wrong, became the greatest wrongdoers, and set examples to their courtiers, sure to be followed for evil in all the gradations of society. It was in the middle rank of

society, with its fewer temptations, that virtue chiefly took refuge; and it was there that woman fulfilled her most useful duties in the family, and was held in highest regard. It is consequently in the greater equality of a republic where her power can be made to be most pervasive and useful; and it is there that men and law should do all that is practicable to aid her best influences, and to sustain the conservative power of the family. Between a republican equality and a Christianity where all are equal in the Divine sight, there is the highest congeniality, and these double potencies should here place woman where she shall exercise her happiest influences.

The peoples of all Europe were virtually divided into classes, during the middle ages, and are so yet. There existed kings and queens, lords, nobility, gentry, and freemen, and yet another numerous class who were not freemen, and were not comprised nor secured in the rights of England's Magna Charta. These, and their children, belonged to their master, and all that they could acquire belonged to him. They were bound to his person or estate, could be reclaimed if they escaped, had no legal redress for wrongs done their persons, and were compelled to do the lowest work, and perform the most menial offices. They were called villeins, and were slaves of the same color and blood as their masters. The name they gave to our language signifies how they were regarded. It is obvious that their condition was, as all slavery is, wholly hostile to the attainment of the highest civilization, and to the best influences of the family relations, and that as regards both master and servant. This thraldom gradually wore out, under the beneficent influences of Christianity, and its last vestige disappeared under the first king of the line of Stuarts. Our own Magna Charta declared all men free and equal, and in terms made no distinction of class; yet was there an exception understood, and described in the Federal Constitution, of the worst phase of slavery.

In the same ages that slavery was expiring, as an effete institution, in England, the merchants of the same British nation and some of her colonists this side of the Atlantic, were busy in planting it in her colonies, and we took it as an inheritance at our Revolution; and without its recognition, the Federal Constitution could not have embraced all the original thirteen of the United States. It was taken by part of the North as a hard necessity, while part voted for it. Its fruits have always been inimical to the best education, and to pure morals in the family, and are now felt in a bitter fratricidal war. Should

it expire as a consequence of that war, it will relieve the Northern conscience of a long-endured sense of national wrong.

That a people may be happy and virtuous, all must be of equal civil rights, and of one grade, except as talents and culture and virtue make individual differences; otherwise it is in human nature that the favored class or classes will degrade and oppress those of lower rank. Woman must be protected by severe laws in all her personal rights, as with us she is, and also by a sound public opinion. Man must not, by law or public opinion, be suffered to have an impunity in trampling upon the weak, or of arrogating to himself more of God's best gift to him, than the proportion provided by the Author of nature. Slavery and polygamy are both incompatible with a just equality of rights, and with human happiness, and are especially destructive of the virtue and beneficent influences of the family. They are evils and wrongs, whose extirpation is always a question but of the means and time of execution.

Marriage between one man and one woman, with fidelity to the marriage vow, is the natural order from which man and woman derive their fullest happiness, and society its best welfare. The equality in the number of the sexes, through all the centuries of time, shows the Creative purpose that but two should become the parents of the family, and when but two, these have the highest incentives of mutual effort for the welfare of the family, without the jealousies and strifes and degradation incident to polygamy. United in affection and counsels, each sustaining the courage and confidence of the other, the two attain a success greater than the aggregate of their separate efforts; their kindly feelings towards each other and their children, have their natural exercise, and these are happiness; and they escape the idiosyncrasies which sometimes make singular those who pass unwedded through life.

Those temperate observances which belong to the family thus constituted, save from the severe penalties that spring from a capricious incontinence, and from a terrible disease, that seems to have been set as a guard to vindicate the natural law of temperance, modesty, and discretion. Population then increases faster, children are better nurtured, more healthy and happy, and become better citizens, for all social and industrial purposes, and for the support of the government. The family, too, if fidelity be observed to its relations and duties, saves man from his worst enemy, himself; saves him from vices that extinguish his affections, vices that cannot be habitually followed without turning his heart to stone. When celibacy and cor-

ruption become the rule, the state is lost: Rome would not have fallen before the barbarians, if the Roman people had not first been diminished and weakened by the loss of the virtues that sustain the family. Their frequent and unscrupulous divorces and transfers by new marriages were more cruel and demoralizing than an authorized and regulated Asiatic polygamy.

The family constituted as we see it, is the most healthy and happy arrangement, though susceptible of some improvement in the best, and of great improvement in the many. There only is found a mutual sympathy and support, many defences against the assailing evils of life, to which separately its members would succumb. While writing these pages I have received the Fourteenth Annual Report of the Mission in the Insane Hospital of our city. The experienced, faithful, and observant chaplain says, "We must remember that the quiet comforts of home do much to keep in tune the harp of a thousand strings. And this brings up the collateral thought that the divine institute of the family builds a wall around the intellect as well as the heart. The isolation of a homeless and unsettled life has always done much to develop morbid mental conditions. The brains which yield are not generally those of the toiling heads of families; the detached in society succumb the soonest. We think the tables of our institutions catalogue this result. Hence, whatever in our social habits inhibits the general prevalence of the matrimonial relation, adds to the harvest of alienated mind. A rational home culture will soon depopulate our asylums; but when will this culture prevail among us?" The Rev. Edward C. Jones, who thus speaks, then adverts to the evil of a demand for wealth before the young will risk settlement in life, instead of being mutually willing to live simply, exertively, and happily, as the chief cause of discouragement of marriages.

It is in sickness and sorrow, "when pain and anguish wring the brow," that the home becomes indispensable to human cure and preservation. One who writes forcibly from observation, and with a humane feeling, though too often disposed to raise a veil that modesty should forbid, says truly, "Nature has bound up life within a triple and absolute tie. Man, woman, child: separately they are sure to perish, and are only saved together." (Michelet.) And many and sad are the proofs he gives in his own country, France; that gayest and saddest country on earth; whose celibacy, and marriage with its sacred pledges unobserved, are alike productive of immensity of misery. Paris is at once the centre of the world's

most brilliant displays of wealth and fashion, and of the exhibition of the most deplorable vice and misery; here in constant and closest contact and shocking contrast. Her levity and brilliancy cannot mask, and, therefore, but mock her woe.

The causes operative there to produce these results, should be beacon warnings to us. There, though there be not legal slavery, is every inequality of rank and wealth, with laws to perpetuate that inequality. There has long been suffered an unhappy loss of religious faith, that has dissolved the sacred attachments of family, and made a jest of promises that should be regarded as holy. There abound women more than can find honest employment and adequate remuneration; and many more men than can obtain wages to maintain themselves and family. These form not families, and know not their salutary restraints, nor enjoy their conservative happiness. Hence the same author says of his own nation, "Woman is no longer esteemed for the love and happiness of man, still less for maternity; but as an operative." Let us hope this is but the darkest side of the picture, portrayed by one who, though painting from the life, paints with strongly contrasting colors. Yet are there writers there who have given us perfect portraitures of women, found even in France.

It is to the families of the commonwealth that nearly all of moral training is to be traced. There the sentiments and principles of religion are effectually cherished and enforced. There spring the impulses of charity, that often surpass in contribution the aggregate of the public revenues. There the sentiments that give tone to public opinion are formed; an opinion that makes and executes the law, and guides the national policy. The families of society are the ballast of the commonwealth, that preserves law and order, in the midst of excitement and disorder, and restores tranquillity after a state has been convulsed by violence and rebellion.

And does the Government demand soldiers for its defence under those circumstances which have occurred in all history, in a world with elements of evil as well as good? It is in the families of the commonwealth that they are to be found in greatest numbers, with the best physical development, and best moral training; with patriotism, loyalty, and intelligent efficiency. These bring with them a double pledge of fidelity, in the love of the family, whose eyes are upon them, and the love of country. These act under a sense of duty that the homeless cannot know. Though war can only spring from evil, and no war can ever arise where one party is not in the

wrong, to provoke or bring it on, we must admit individuals may, nay, must, act under the most exalted sense of duty, when they peril life for the love of their country.

Professor Peabody bears strong testimony to the value of the family in this comprehensive summary. "While filial obedience alone can train worthy subjects to the state, there are yet other aspects in which Government depends on the home-life, and is sustained by the family relation, so that, for a homeless community, anarchy or despotism would be the alternative. To an incalculable degree the home instinct supplies the place of law, supersedes the harsher ministries of government, prevents crime, anticipates want, divides and lightens burdens, which else no public organizations could bear. The gravitation toward home is in every nation a stronger force than its police and armies are or can be, and accomplishes many purposes of prime importance which they could in no way fulfil. The few homeless members of a community are of immeasurably more charge, burden, and peril to its constituted authorities, than the overwhelming majority that have homes." As much then as we should hold government and law in honor, and cherish the sentiment of loyalty to it, we owe the like regard to that smallest civil institution, the family; for without it social order could not exist, government could not live, except it be as a despotic force, to rule by military restraint the chaotic elements of an unorganized people, preferring misrule, license, and disorder. Such people could be no law or police to themselves.

To encourage the family and its beneficent influences, we must discourage all that militates against it. All systems of communism that tend to loosen the ties of family, or to dissever those ties, or to prevent the formation of families, are to be discountenanced as normal institutions. Indeed, from the nature of man, these can never be the general order of society. Spartan citizens may be separated from their families, and be trained to the endurance of self-denials and hardships, and to the observance of secrecy, by the iron discipline of a Lycurgus; and religious orders, fleeing from the world, repentant of their sins, may carry their self-discipline and penitential inflictions to the extreme of human endurance, as imposed by a head inexorable as a Loyola; but surely these results will be attained at the fearful sacrifice of all that is genial in social life, and of all that can make this life a happiness to its possessor. Modern reform communities may be formed with the good purpose to make life more cheerful and happy, as we have seen a number in our day; to

obtain more economically the physical means of livelihood, with more of literature, science, and social amusement. Yet such a social community is an artificial creation; and not resting on a natural basis, it is formed but for a transient existence, and then to expire. There are always in these too many heterogeneous elements brought together; and these have not the powerful family interests and affections to preserve harmony, or to produce reconciliation. Diversify the employments, instructions, and amusements as you may, the machine, if it moves smoothly, will move monotonously; and if it will not move smoothly, the parts will clash; and in either way will run down, without power to wind itself up.

There are, it is true, religious communities, enjoying celibacy, which have an enduring existence. The deeply absorbing interests of a common faith and worship, and sometimes more potently, perhaps, persecution, holds them together. Their members are the exceptional beings who have renounced the affections and ties of the world, as well as sought refuge from its temptations and trials; have also renounced in part the affections of their own nature; and, except as they can anticipate the joys of heaven, theirs seem to us to be but as a semi-life, or a semi-death. Yet these institutions have a mission on earth that is touching to the sentiment of humanity. They are places of retreat for those stricken with sorrow; those for whom this world's flowers of hope are blighted, its fruits been turned to ashes; foot-sore pilgrims, who, without joy in life, dare not anticipate that transition they so much desire. Here these may tranquilly rest, and waiting, not only find the consolations of devotion, but in their visitations of mercy to the afflicted, or in the education of youth, may become the best of human benefactors. Yet these must be exceptional, or the world would not be peopled, nor souls be multiplied for earth or heaven. It is the family of parents and children that we must look to as the true source of population, of moral and educational training, and as the natural basis of society and good government. God has instituted it, and it must so abide forever; and we must care for its members as we would save society.

Have I seemed to place undue importance on the power of woman and the family to advance the world's well being? Listen then to some of the world's eminent theoretical legislators.

Jeremy Bentham, in his Theory of Legislation says, "Marriage, considered as a contract, has drawn woman from the severest and most humiliating servitude; it has distributed the mass of the community into distinct families; it has created a domestic magistracy; it

has formed citizens; it has extended the views of men to the future, through affection for the rising generation; it has multiplied social sympathies. To perceive all its benefits, it is only necessary to imagine what men would be without the institution."

The Baron William Von Humboldt, formerly Privy Councillor of State and Minister of Worship and Public Instruction in Prussia, in his treatise on "The Sphere and Duties of Government," speaks upon the subject in language more closely bordering on eulogy, and ascribes to woman a higher ideal of human excellence, both in her conception of it, and in her practical fulfilment of that conception. He advises against governmental interference in the formation and regulation of a relation so delicate as that of matrimony, which must rest, to be successful of happiness, on mutual inclinations; though the government be most deeply interested in population, and the early training of youth. He says, "After careful observation, it has been found that the uninterrupted union of one man with one woman is most conducive to population; and it is likewise undeniable that no other union springs from true, natural, harmonious love." He, while disclaiming the policy of the state's interference by law that commands, to mould the arrangements that belong to nature's mysterious elective affinities and to the sacred precinct of the family, bears his testimony to the fact, that "experience frequently convinces us that just where law has imposed no fetters, morality most surely binds." And as it is wise for the law to forbear the exercise of its coercive power, so long as inclination and a sense of duty rule to the end the law most desires, so the husband, with whom is the final family authority, should forbear to interfere so long as the wife and mother are, with adequate intelligence, performing the functions of domestic rule, with a wiser government of blended authority and affection than belong to his sterner nature. Of woman's fitness for this high task he speaks in terms of glowing eulogy, surpassing those I would think proper before this grave audience; for in her he beholds concentrated "each human excellence," "the whole treasure of morality and order;" saying, with the poet,

"Man strives for freedom, woman still for order."

That "while the former strives earnestly to remove the external barriers which oppose his development, woman's careful hand prescribes that inner restraint, within whose limits alone the fulness of power can refine itself to perfect issues; and she defines the circle with more delicate precision, in that every sense is more faithful to her simple

behests, spares her that laborious subtilizing which so often tends to enmesh and obscure the truth, and enables her to see more clearly through the intricate confusion of human relations, and fathom at once the innermost springs of human being." This is modern German testimony to an inherent quality in woman, from a highly cultivated source, in a civilized age; yet in accord with that borne by Tacitus, as to the ancestors of the same race, living on the same spot, nearly two thousand years before, but then, by polite Rome, called "savage."

The Baron Humboldt is evidently speaking of a woman of superior intuitions and culture; and unless the wife and mother be of an intelligence and disposition to enable her to fulfil her domestic duties in a successful manner, all that is here averred to be her appropriate and beneficent power and influence will be without its assumed foundation. We see then what should be the endeavor, that woman may fulfil her mission to the world; we may also see what this should be by countless examples; examples which should be made the prevailing examples, that society may attain its highest, happiest condition. Of such, we may agree, the poet is not extravagant in description and praise:

"A being breathing thoughtful breath,
A traveller betwixt life and death;
The reason fair, the temperate will,
Endurance, foresight, strength and skill."

"With yet a spirit still and bright,
With something of an angel light."
WORDSWORTH.

And, elevating our views above the ordinary affairs of life, it is in the wife and daughter, with their higher susceptibility to a religious faith, men find the most persuasive influence to believe and act as they, with a purer purpose and more earnest hope; since the fruits are so surely demonstrative of the truth of their faith, in the practically seen beauty and happiness of holiness. Whatever may be the difficulty or obstruction in the mind of the father of the family, none who truly loves his children, and looks forward to their welfare through life, and in its exit, but desires that they may possess the pure and unhesitating faith of their mother; that they may the better resist evil, and be sustained in trials, in sickness, and in death. And it must be conceded that it is mainly in woman's more susceptible sympathies and intuitive initiation in Christian truth, that she has very often been a pioneer of Christianity and the world's civilization. For one, I confess to the long-entertained belief, that if woman had

not been constituted with more humanizing tendencies and a more trustful faith than man, religion could have had but little hold upon mankind, and civilization would never have been. I say this with the same deliberate carefulness of observation and thought, with which the naturalist gives us the result of his careful observation of what he describes in the animal kingdom.

The family is indeed a divine institution, and beneficent in all its influences. The first thought of it, in the mind of virtuous youth, is highly educational, by impulses that are of Creative origin. As surely as that the pulsations of life have been given by the Creator, so surely must have proceeded from Him the emotions that conduct to the connubial compact; and these are, or should be, elevating and refining. Youth has a quick perception of the comely in person, graceful in manners, and perfect in moral excellence, and beholds these qualities to admire and emulate them. And what they admire the two sexes seek to be, that they may be acceptable to each other. This saves the young man from the peril of degrading association; and it is under the influence of love, and in obedience to its requisitions, that man is inspired to dare and achieve. It is by this that the world receives in the great aggregate, its mightiest onward impulsion. Man, nor woman, would ever struggle, strive and achieve as we witness, but to be united in happiness and to maintain and elevate the family in comfort, respect, and honor. Without the family, society would lose more than half its industry and enterprise; the nation much more than half its resources and reliance for the maintenance of order and of good government.

The law calls marriage a civil contract: it is not the less a religious one,—religious, by the law of nature, and by the law divine. The Holy Scriptures bestow upon it their highest sanction, and in all its relations their terse and comprehensive commands. Have said of the husband and wife, "They shall be of one flesh." Have given the commands, "Husbands, love your wives;" "Wives, submit yourselves unto your husbands." Have bid him remember that she is "the glory of the man." They have said to the child, "Honor thy father and thy mother;" to "children, obey your parents;" to "fathers, provoke not your children to wrath;" to servants, "count their masters worthy of all honor;" to masters, know "that your Master is also in heaven." And Jesus called the little ones unto him, saying, "Of such is the kingdom of heaven." Thus on every side all those who make the family, are the objects of the Divine regard and protection. And on this sacred authority, in living with our children, unless we have

marred Heaven's highest gift, we are already loving those nearest like unto celestial beings.

In considering the members of this little community, whose repetitions make the commonwealth, it is unprofitable to advert to the often contested point of the mental superiority of the sexes; for each is incomparably superior to the other, in the respective spheres of action most obviously assigned them by their Creator. Without their inherent differences the family could not be made up; would not have its sustaining attraction and interest. These differences make the accord of the whole. Without the husband performed the duties for the family he is best fitted to fulfil, or, if the wife performed not those she is best qualified to perform, they never would be well performed; and without the beautiful relations which we perceive to be harmoniously maintained under the influence of the affections, the family could not continue to exist; and with the loss of these domestic ties and relations, all that is most humanizing and conservative of the welfare of the race would be lost. It is very true, as Michelet says, "To educate a daughter is to educate society itself. Society proceeds from the family, of which the wife is the living bond."

Are we curious to consider the nature of the government that belongs to the family? Let us try the comparison then between this and other forms of government. It is not a monarchy; nor an aristocracy; nor a republic. True, the law regards the husband as its head; and in relation to law and to the political government, this is generally his position. But in the family, happily constituted, he is not king, nor sole ruler. The wife and mother must share his rule, and must constantly perform many the most duties of that rule. Yet, is she not queen; at least, not queen-absolute; for his authority is paramount, if, unhappily, they differ. But she is more than queen-consort; for the government is not that which He intended who set them in family, if their power be not conjoint and harmonious. If the husband be wise, and wisely mated, the ostensible rule of the family will be hers, who is most constantly present to regulate, order, and compose all differences. She will, therefore, be more than queen-regent; for she exerts, not a merely delegated, but her own authority, as well as his; with the advantage of his counsel in the executive council chamber of two; where, indeed, he may have a veto power, to be sparingly exercised. What she is, and what she will do, if she be prudent and wise and exertive, the mother of King Lemuel has inimitably described: "Her price is above rubies. The

heart of her husband doth safely trust her." "She openeth her mouth with wisdom, and in her tongue is the law of kindness. She looketh well to the ways of her household, and eateth not the bread of idleness." (Prov. 31.)

This domestic rule combines powers that would be most dangerous, if united in the hands of a single political executive; of one who combines the legislative, judicial, and executive authority. But in the institution of the family, this concentration of powers is not dangerous, as a general rule, while it must necessarily exist. They are virtually in one; for in their exercise, husband and wife must act as one. Their dual reign must have the concert of unity of counsel and of action; will be tempered by the love of children and their love of each other; and will be restrained by the ceaseless consciousness towards the residue of the family, that they who are masters on earth, "have a Master in heaven." If these influences be forgotten, the family is not that which God intended to set together; and he who violates that intent, is traitor both to God and his own happiness. He who is despot in his family, must expect that family to reflect no joy to him. And many there are who perform their moral obligations respectably well, who know not how much more of happiness lies unelicited within their easy reach, for want of genial and social attractiveness to wife and children; whose happy social sensibilities are chilled, or not drawn forth in those reciprocations that give home its joys and life its purest happiness.

Pardon my having so long dwelt upon that which is obvious to you all. It is with purpose to impress upon others, and women themselves, how available may be made their influence and that of the family, for the advancement of human welfare and civilization. Evidently, the Creator has intended the fulfilment of a higher mission than man or woman has yet generally fulfilled. Countless are the examples of exalted excellence and virtue in both; but these are to be multiplied everywhere and constantly. Yet will the moral safety of mankind rest mainly with woman:

> "Spirits are not finely touched
> But to fine issues."

So said the master observer of the human heart. And finely touched spirits can alone reach to touch and mould the tender and impressible heart of children, and leave upon it impressions that shall endure through life, and after life. For that duty, neither the father nor the teacher will adequately suffice. Their ruder appliances and tem-

per, the rude nature of the boy resists. It is the mother only that can soften his rugged tendencies; and she alone is fitted to guide and impress the gentler sex. She alone has the patient endurance to continue the task of saving the son she has borne, when bent on vicious ways, hoping against hope, to save him from himself, for himself, for his family, and for his country; and to save him for that family union hereafter, which she ever fervently prays may be complete, no one missing. It is from her maternal solicitude and ceaseless efforts, thus undespairingly exerted; to her ministrations in the first and best temple of worship, next to the purified heart, the home, at whose altar she is priestess, that nearly all that is good may be traced; and especially, that influence, that after many years of alienation, during which the heart has been pierced by many sorrows, will bring back to the native hearthstone the prodigal son. That this is her higher mission, and that she is better fitted for it than man, he need not be jealous; for so the Creator has willed it, and it is for the common good. Let it be his care to aid and never to thwart these her efforts, for they spring from sacred impulses. Their spheres are diverse; and though his high duties be indispensable, hers upon the family are the more important, and the effects more enduring. A more important and elevated sphere she cannot attain and seldom should desire; and she descends from the highest when she attempts to leave it, and not often attempts it without disparagement to herself. Yet woman is not to be too closely restricted to the indoor round of domestic cares, especially after her children have grown to an age to share them with her. Age often sets her free to fulfil the mission to which her generous nature prompts. In many charities, this nation and age, more than any other, have witnessed, how invaluable and devoted have been her self-sacrificing services, in behalf of the uneducated, the insane, and the poor; of the sick, the wounded, and the dying soldier. A censorious world must not, after this age of sacrifices, be indulged in its too great jealousy of woman's strivings to do all the good of which she is capable, to all human sufferers. Her sacred purpose, and the good accomplished, must sanctify her deeds in the breasts of all good men.

We are not disparaged, but exalted, and society and the nation is exalted, when woman is held in honor, and is enabled to dispense her best influences round us. An eloquent French author says truly, "If we wish, then, to know the political and moral condition of a state, we must ask what rank women hold in it. Their influence embraces the whole of life. A wife; a mother; two magical words, compris-

ing the sweetest sources of man's felicity. Theirs is the reign of beauty, of love, of reason. Always a reign! A man takes counsel of his wife; he obeys his mother; he obeys her long after she has ceased to live, and the ideas which he has received from her become principles stronger even than his passions." Aime Martin, to write thus, must have found good women in France; women to redeem their country from our too severe censures.

The inductions to be made from these truths are plain, and the duty the most imperative man can know, since the welfare of his posterity, the prosperity of his country, the enduring happiness of all human beings, are involved. Woman is to be trained with a fuller appreciation in herself of her high trust, and of her capacity for good or evil; and if she be good and worthy of her trust, man is to learn to confide in her generosity, to honor her, and to sustain her authority for good, as something better and greater than his own. His children are to be kept as much and as long under her control as possible, even while they are obtaining their school and college education, and under her influence for life. Women are to make home the happiest place in the world, and husbands and sons are there to find their happiness, and to cultivate kindness and the courtesies of life. If sometimes they seek amusements abroad, wife and sisters should share them. Let them seek no luxuries in selfish seclusion. Let this be their general practice, and how many drinking and gambling houses would there not cease to exist, and club-houses exist only for the cheerless unfortunates who have no family. Hotels would be for travellers; and haunts of vice, not to be named, would be few. The city at night would sleep in peace, its silence unprofaned by inebriate brawlers; prisons and almshouses become of diminished necessity. It is the homeless and traitors to home that cause the chief public charge. Then a public opinion could arise, now too feeble to suppress or restrict by law these sources of countless evils and sorrows, and woman be often saved the most terrible calamities ever inflicted upon humanity, and from which death only can relieve her.

It is not for us in America to boast of our advantages, but to express an overflowing gratitude for them, and leave examples that are good to exert their silent and enduring influences upon other peoples. We may not be boastful, for we yet see large room for improvement, and for the expansion of the good we witness. Yet may we rejoice in the testimony borne of us by recent travellers of the highest intelligence, who have marked a contrast favorable to us as compared with our parental nations of Europe. "You may estimate the mo-

rality of any population, when you have ascertained that of the women; and one cannot contemplate American society without admiration for the respect which there encircles the tie of marriage. The same sentiment existed to a like degree among no nations of antiquity; and the existing societies of Europe, in their corruption, have not even a conception of such purity of morals." (De Beaumont.) "The marriage tie is more sacred among American workmen than among the middle classes of various countries of Europe." (Chevallier.) "One of the first peculiarities that must strike a foreigner in the United States, is the deference paid universally to the sex, without regard to rank or station." (Lyell.)

Moral and religious influences have been dwelt upon as the sources of the welfare of the family, and through the family, of society. What, then, has or can the law do for the same object? It has done much, and may do more; yet the main reliance must ever be upon moral and religious influences that have their operation in the susceptibilities of the human heart. Volumes of law have been written on the domestic relations, defining the rights and duties of husband and wife, parent and child, guardian and ward, and master and servant. These are well and wisely written, yet have regard chiefly to property and government; but law cannot reach to enforce the moral and religious sentiments from which spring the highest culture and truest civilization.

The law has done much less than it might do, because public opinion, that springs from culture and civilization, has not sufficiently advanced to enact and maintain the laws needed for human reform. It is owing to this, that we have not laws adequately restrictive of intemperance, and do not enforce laws that exist against gambling and other vices.

The ancient and existing statutes against vagrancy are the law's assertion of the duty of every one to be a member of a family of fixed locality, and it provides a public habitation for all that have no home,—the Prison, Almshouse, or Refuge.

Law, public opinion, and the habits of our people, have been most beneficially operative in building our City of Philadelphia in an adaptation to the separate residence of each family, and consequently most favorably for the best family influences. Here is provided one house for nearly every family, and of a size and expense convenient for almost every family. When we consider that each house now built, of whatever size, generally has all the conveniences for fire, gas, water, and baths, and that in each may live a family upon the

moderate earnings of the artisan, independently of every other family, with more conveniences and comforts than the most wealthy enjoyed less than half a century ago, it is with a pleasing and grateful feeling that we contemplate the expansion of this largest city of our continent. Its expansions, too, are not like those of some cities, in narrow and uncleanly lanes and alleys, and by mean and neglected dwellings, but on some sides by houses of superior architectural style, and on others by rows of smaller dwellings, neat, cleanly, and complete in comfort. It is much more a cause of satisfaction to reflect that we have the largest city, with the best accommodations for its hundred thousand families, than to have a population of a million or more, compelled to live two or more families in a house. And the law provides, by supervision of inspectors and the enactment of penalties, that houses shall be substantially built, secure from fire, and with ample adjoining space for the admission of fresh air. No more narrow alleys or courts can be built upon for dwellings, nor any dwelling house without an open curtilage of 144 superficial feet. In such a city, when the old parts shall be rebuilt, there can be but few confined places to breed physical or moral disease and contagion, or riot and rebellion. To the providence of William Penn we owe it that public squares afford places of exercise and for fresh air to all families in the centre of our city; and the Consolidation Act makes it the duty of Councils to continue to provide them; a duty that is not sufficiently regarded, but a duty that should be fulfilled by purchases, and not by the arbitrary power of taking the property of the citizen at a price to be fixed by strangers to him, whom he has not selected, and would not trust.

The law has so provided for the education of children in our city and commonwealth, that every one may be educated at the public charge, without any expense to parents for books or tuition. So far as school education can make good members of the family, and good citizens, the law has provided the means, and parents are derelict to their duty who do not make this resource available for the improvement of their children. It is true the law does not coerce the attendance of the children at the schools, yet it is well for negligent parents to know that if their children prove vicious, for want of a proper home and school education, the public has such a paramount interest in them, and in their preservation from vagrancy, crime, and cost to the community, that the law has provided for their being taken charge of, to be better trained, protected, and educated, in the Children's Homes and Houses of Refuge, whence, as from the Almshouses,

they are bound apprentices in families, while other benevolent institutions and individuals are busy in promoting a juvenile emigration to the West, of exposed and destitute children, there to be absorbed healthfully and usefully into the respectable population of that teeming region. The right of parental control is a natural one, but is forfeitable when parents are derelict in duty to their children and the community, and may be superseded by the *parens patriæ*. (4 Whar. Rep. 11.) It is under this principle, sanctioned by the Supreme Court of the State of Pennsylvania, that vicious youth are placed in the House of Refuge, to be removed from temptation, and put under training and apprenticeship, to fit them for usefulness in society.

Parents should consider that they cannot think too highly of their privileges and responsibilities in respect to the public provisions made for the education of their children. None can say that within their own little family may not be cast those minds who are to be the benefactors of mankind and the light of the world, and that as well in the families of the poor as of the rich. "God is no respecter of persons." Great, then, is the privilege available to all, to have the provided means of developing the intellect that may afterwards self-achieve an endless good and undying renown. No parents, poor or rich, can say that there shall not be found among their little ones a future Augustine or Fenelon, a Galileo or Newton, a Luther or Latimer, a Franklin or Washington.

The law has long entertained the highest regard for the marriage relation, and the welfare of the family. Its policy, derived from the Roman civil law, is to encourage marriages, and the rearing of children, that they may become a strength to the state. As a general rule, the law in the disposition of property, permits of no legal restraint upon marriages, except during minority, and that only for the advantage of the inexperienced and the immature in judgment. Conditions annexed to legacies against marriage, are simply void, and the legacies absolute. The law's policy regards with disfavor the interference of any mercenary agency, and declares void all contracts of marriage brokage. Its policy seeks that all influences shall be pure that are to lead to a consummation so holy as marriage; one that so much concerns the public welfare and private happiness. The law desires that mutual affection, alone, should be its attraction; and then there is a natural guarantee for the mutual happiness of the parents, and a faithful nurture and education of the children of the Republic. In this, as in all questions of wise public policy and pure morals, the

ethics of the Judiciary are perfect, and their rule inexorably applied. No man can successfully assert a claim in a court of justice through a wrong, or gain a case that is against sound public policy, or is infected by the taint of immorality.

While the law encourages marriages, its policy is not to encourage thriftless and unhappy marriages. These do not attain its desire any more than that of the parties concerned. It should be its policy, and the present improving public opinion that will in the future dictate its policy is, that women shall so share in industrial pursuits, that those single may both feel and be so independent as not to feel coerced, by circumstances, into unsuitable or improvident marriages. To this end the philanthropy of our age and country is largely engaged. The result will naturally be, that by making women more independent in character and circumstances, they will not only be rescued from a temptation to err, but be rescued from the dreary inanity of want of occupation, and become objects more worthy to be made, therefore more sure to be made, honored companions in lawful wedlock.

The common law of England was so much founded in a feudal and military policy, and in the necessity of a single head to represent the rights and duties of the family, that the legal existence of the wife was considered as merged in that of the husband. In the law they were one person, so that if lands were conveyed to husband and wife and their heirs, the survivor, as the continuation of that person, had the fee. By marriage the husband had an estate in the wife's lands as long as both lived, and if they had issue, he had a life estate, to continue after her decease, by the curtesy of England; and by marriage he became owner of her personal property. All this has been defended and maintained down to a recent date, as requisite to the necessary authority to be maintained in the head for the welfare of the family; but it assumes that the wife could not be trusted to exercise a sound discretion, or possess that affectionate interest in the welfare of all the members of her family, to induce her to make a wise disposition of her revenues for their common advantage and advancement. There are many instances where such distrust will be justified, but they are the instances to be avoided by wise and discreet men, who are seeking the wife to be the mother of their children. As the rule, it may be assumed that the wife and mother will be ever ready to give her income for the family wants, and is often but too ready to yield the capital also. The vicissitudes of business are such that it often occurs that the wife's property affords the happily

retained resource for rearing the family in respectability, when the husband's property has been swept away by the resistless tide of a commercial crisis, or, perhaps, been lost by his own indiscretions, not to say, his vices. Experience teaches, as the rule, that the wife's property should be settled to the separate use of herself and children, with such control over it, after her death, vested in the surviving husband, as will hold a worthy father in the respect of his children, and give him a salutary control over them.

Deeds of settlement, or trusts created by will, in times past, held the wife's property to her separate use; and these are yet the only safe reliance. It is true, recent legislation, in many of the States, declares that her property shall remain hers after marriage as before, and be subject to her own disposal by will, to which he must not be a witness, and it is not liable for his debts, during her life. This is well; yet is she exposed to an undue influence, and a coercion that the magistrate cannot probe. She cannot convey her property by deed without the husband joining with her, nor without herself undergoing a separate judicial examination. That is, she is not to convey without him, that she may have his protection against the imposition of others; nor without the judicial examination separate from him, that she may have the magistrate's protection against her husband's quite possible undue influence. The proceeds of the sale she may give to him in the absence of a trust. Each can dispose of his or her property separately by will, but with this exception, that the will of a husband is subject to the widow's right of election to reject the will, and in lieu of its provisions, take one-third of his real estate for life, if he leave issue, and one-third of the personalty forever; and if he died without any issue, her right of election will extend to one-half of his estate for such durations of time; and the wife's power of disposition of her property by will, is subject to his estate for life in the whole of her realty, and to his right to take in lieu of curtesy such share of her real and personal estate as she could have taken of his real and personal estate; that is, one-third or one-half, accordingly as she left issue or not, and for the same duration, of time. But her property held in trust would only go according to the limitations of the trust; or to the dispositions made under the powers expressly reserved or given to her by the trust instrument. A firm trustee is a great assistance to her in the preservation of her property, if her dispositions be required to be made with his consent.

It has been the good fortune of the writer to be enabled to effect legislation, to some extent, for the further benefit of the wife and

family. It is now the law of Pennsylvania, that whensoever any husband, from drunkenness, profligacy, or other cause, shall neglect or refuse to provide for his wife, or shall desert her, she shall have all the rights and privileges of a *feme sole* trader; that is, shall have ability, as a single woman, to make contracts and carry on business; and her property, real and personal, shall be subject to her free and absolute disposal during life, or by will, without any liability to be interfered with, or obtained by such husband, and in case of her intestacy, it shall go to her next of kin, as if he were previously dead. The mother is substituted to his former rights over their children, and she is to assume his duties; place them in employment and receive their earnings, and bind them apprentices; provided she be worthy of the trust, and the Court shall decree her this independent *status;* otherwise the Court is to appoint a guardian for the children. And no such husband, who shall have refused to provide for his children, for the year preceding his death, shall have the right to appoint for them a testamentary guardian. (Act of May 4, 1855.) Again, it had been the hardship of a deserted wife, that her own earnings might be recovered by her worthless husband; and he might himself be, or prompt another to be, her defamer, and yet she could maintain no action for redress, without its being in his name and subject to his control; for remedy whereof it is enacted, that the deserted wife, in case of defamation, or suit for her earnings, may maintain the action; and if her husband be the defendant in an action of defamation, she may sue in the name of a next friend. (Act April 11, 1856.) Thus the unworthy husband and father may forfeit his high position, and the worthy wife replace him in it. This righteous legislation came only after ages and centuries of injustice and wrong, and so far as known to the writer, only yet exists in one of these States.

It is the unhappiness of some persons, married and unmarried, to have no children on whom to bestow their care and affections, while others have more than they can conveniently provide for and educate; and there are often orphans without relatives to provide for them. It is provided by a section of the Act of 1855, that persons, by certain judicial proceedings, may adopt a child or children, and give them their names and all the rights of heirs, and the parties become, with reciprocal claims and rights, subject to all the duties of parents and child. This law may often fill a void in the family needful to its happiness, tend to equalize the blessings of life and fortune, and prove of inestimable advantage to orphans and other children destitute of provision. The natural parental and maternal love unblessed

by offspring may thus be satisfied, and life become a higher blessing to the adopting parents, by the consciousness of doing a present and future good, to unprovided and helpless children.

As great as are the advantages of marriage, and sacred as are its ties, the law cannot do less, from sheer humanity, than relieve the innocent party by divorce, when the other has so grievously violated the conditions of the compact, as to make the continuance of the relation a participation in guilt, or so oppressive as to make life burdensome or an intolerable slavery. The wrong would in such case be, to coerce a cohabitation, when it would be productive of consequences precisely the reverse of those intended by the institution. If either party has, by vicious habits, alienated him or herself from the duties that he or she engaged to fulfil, and has violated the solemn marriage promises and obligations, he or she is no longer one joined by God, but is already dissevered; therefore, the law says, as to those whom the Lord doth not longer join together, let man put asunder. In ancient times, except among the German nations, the husband generally divorced the wife at his pleasure or caprice, by himself giving her a writing of divorcement; a power permitted the Jews by the law of Moses, as our Saviour said, because of the hardness of their hearts; but in Christian countries the power is only exerted by law, for causes reciprocally operative against a husband or wife, who has forfeited the marriage rights by a violation of its duties.

But, I repeat, it is not to law so much as to other influences that we are to look for human improvement through the family. These must be moral and religious influences. And is there not in these a philosophy fittingly to be spoken of in this Hall? The science that teaches us how to live and how to die must be the most important of philosophies; and the science is as sure and logical in its laws of cause and effect as any other science; and is so much the more important than any other, that it the most nearly concerns human happiness. It may be said, perhaps truly, that there can be little or nothing that is new to be disclosed in morals and religion. Though that should be conceded, one thing remains to be certain, that as long as we live we can always be advancing towards that standard of perfection, that we are bidden to strive to attain; a standard that we may but hope to approximate; a measure of improvement which the most civilized nation has not yet half fulfilled. From this delinquency the recovery must mainly be through the better training and education of the family.

But following from habit and example in the steps of our predecessors, we take too little thought of the capacities of improvement in ourselves and families. And though there seems to be little scope for an increase of learning in morals and religion, there is always great room for practical improvement. Each individual may ceaselessly increase his knowledge and improve his social manners and affections; and multiply the applications of known truths; and in every step of this progress other truths will dawn upon the mind with ceaseless increase of light and of the joy of life. Let not then the familiarity of the subject make us forgetful of the duty of observation, reflection, and advancement, in this small, ever present, and always interesting centre, but of ceaselessly expanding influence and power, the family.

In dwelling upon this familiar subject I have been led to consider how prone are mankind to overlook the significance of things most commonly present to them; and though the subject in hand may not admit of scientific discovery, yet the moral consequences to result from a better understanding of it, may so far surpass in practical benefits the most brilliant discoveries in physical science, as to make our labors in this field of practically the greatest importance to mankind. Physical discoveries are always most valuable; and if seemingly for nothing else, are so in the discovery of the Creative wisdom; but in practical purpose rise in importance as they minister to human welfare. Let us illustrate by a few instances how blind mankind have been to things the most familiar to them; as to which philosophers, some of them our predecessors in this Society, have made discoveries which have conferred glory upon their names and upon philosophy. All men, through all the lapse of time since men peopled the earth, had beheld the light with admiration, praise, and even worship; but thought it a simple element, until Newton analyzed its rays into the prismatic colors, although they had seen their prismatic separations as refracted by the atmosphere, before the rising and after the setting of the sun of every unclouded day, through all the ages of human existence. Men had always breathed this atmosphere, upon which we hang at every moment for its life-giving inspiration, and in all time they had supposed it to be another simple element, until our Dr. Priestley, in but the past generation, separated its simpler elements, and found one of its gases to be that which sustains alike combustion and life; the other to dilute that burning oxygen that else would destroy all life. The water, which all men drank as another necessity of life, they supposed to be another ele-

ment of nature, given as the conquering enemy of fire, was also divided into its constituent gases, and these, as recombined by the compound blowpipe of our Dr. Hare, produced a heat hotter than the thrice heated anthracite furnace. The lightning, which all mankind, of all ages, had beheld with wonder and superstitious awe, as it flashed through the skies, leaping from cloud to cloud and from heaven to earth, detonating in stunning thunders, was proved by our Dr. Franklin, as he drew it harmlessly from the sky, to be electricity; and now men make it bear their messages of business and command, with the lightning's speed, over this globe. And we see it, in this our day and country, performing duties of mightiest potency, since from the central capital it carries the commands that move the distant armies spread over our wide continent, in that concert of action that insures victory and safety to the legitimate Government of the nation.

These are discoveries most interesting, most useful, most brilliant; and no such discovery and renown can reward the reflections of him who devotes himself to the social, moral, and religious improvement of his fellow men. Yet let not the legist, moralist, or the preacher, be discouraged, but console himself in this, that whatsoever good he may do shall achieve a success in a domain of yet higher import than all physical discoveries; that he may elevate the moral standard of humanity, and create a virtue and happiness that shall belong to two existences. If mankind shall fail in these, then will they fail in the highest purpose of the Creator, and make creation itself a failure. If this shall be the event, what then shall import all wealth, all power, all science, all knowledge? what this air we breathe, this earth we tread, and all its fruits; its bright waters, its glorious light and electrical coruscations; all that shall sustain all life, and all that shall yield to the physical philosophers their rich harvests of glory? They become worthless all, if man shall betray his highest trust and fall. If man prove worthless, these are worthless all! Truly, then, there is a philosophy that transcends and comprehends all other philosophies, the philosophy that teaches man how to live and how to die.

On motion of Mr. Fraley, Mr. Lesley was chosen Librarian for the ensuing year.

The Standing Committees for the year were then appointed, as follows:

Committee on Finance.—Mr. Fraley, Mr. J. F. James, Mr. Powel.

Committee on Publication.—Dr. Bridges, Mr. T. P. James, Dr. Ed. Hartshorne, Prof. Coppée, Dr. Wistar.

Committee on Hall.—Mr. F. Peale, Judge King, Prof. Coppée.

Committee on Library.—Dr. Bell, Rev. Dr. Stevens, Dr. Coates, Mr. Price, Rev. Mr. Barnes.

The list of surviving members was read, and corrected by the announcement of the death of Prof. Joseph S. Hubbard.

Summary.

On the List, Jan. 7, 1863, ...	U. S., 255,	Foreign,	136
Elected in the year 1863, ...	U. S., 24,	"	16
Deceased reported in 1863, ...	U. S., 12,	"	4
Number of members, Dec. 31, 1863,	U. S., 267,	"	148

Pending nominations, Nos. 506, 507, and new nomination 508, were read.

The Society then proceeded to ballot for members, and the ballot boxes being opened by the President, the following persons were declared duly elected members of the Society.

Prof. A. Morlot, of Lausanne, Switzerland.

Prof. Thomas Chase, of Haverford, Pennsylvania.

And the Society was adjourned.

Stated Meeting, February 5, 1864.

Present, twenty-one members.

Dr. Wood, President, in the Chair.

Letters accepting membership were received from Prof. Thompson, dated Copenhagen, November 11, 1863, and from Prof. De Koninck, dated Liège, January 15, 1864.

A letter was read from the Royal Society, dated London, January 7, 1864, requesting the co-operation of this Society in completing or making as perfect as possible the Catalogue

of Scientific Memoirs, for some time in course of preparation by the Royal Society, and now nearly ready for publication. A list of Journals and Transactions of societies included in the Index accompanied the letter.

Letters acknowledging the receipt of publications were read from the London Geological Society, November 4, 1863; the Royal Astronomical Society, London, October 17; the Scientific Commission of the Royal Zoological Society of Amsterdam, August 25; Mr. Troyon, of Lausanne, August 7; the Royal Academy at Turin, August 11, and the Royal Saxon Society at Leipsig, October 10, 1863.

Letters announcing or accompanying donations for the Library were received from the Harvard Observatory, January 20, 1864; the Royal Geological Society, London, November 20, 1863; the Royal Zoological Society at Amsterdam, August 25; the Royal Saxon Society, Leipsig, August 22 and 29, and the Imperial Academy at Vienna, August 25, 1863.

Donations for the Library were announced from the Academy at St. Petersburg; the Central Russian Observatory; the German Geological Society; the Royal Saxon Society; the Imperial Geological Institute and Imperial Academy at Vienna; the New Astronomical Society at Heidelburg; the Royal Zoological Society at Amsterdam; the Geographical Society, and M. Delesse, at Paris; M. Des Moulins, of Bordeaux; The Royal Academy at Turin; the Royal Society, Royal Institution, Royal Astronomical, Royal Zoological, Chemical, and Linnean Societies, and Society of Arts, of London; the Bath Agricultural Society; the Royal Dublin Society; Harvard College; Mr. G. P. Bond; the American Academy; the Boston Society of Natural History; the American Journal of Science; the Academy of Natural Sciences; Mr. F. Leypoldt, Messrs. Blanchard and Lea, and Mr. Isaac Lea, of Philadelphia; Mr. T. U. Walter, of Washington, and Mr. A. S. Taylor, of San Francisco.

Donations of photographs for the Album were reported as follows: two of Richard Lepsius, one of L. De Koninck, one of David's bust of Humboldt, one of J. F. Encke, one of M. Troyon, one of Leopold Von Buch, and one of M. Delesse.

Mr. Price continued the reading of his communication upon "The Family as an Element of Government."

Pending nomination No. 508 was read.

The letter of the Secretary of the Royal Society was then considered, and on motion, the subject was referred to the Secretaries, with power to act.

And the Society was adjourned.

Stated Meeting, February 19, 1864.

Present, fifteen members.

Dr. Wood, President, in the Chair.

A letter accepting membership was received from Thomas Chase, dated West Haverford, February 18th, 1864.

Letters acknowledging the receipt of publications were received from the German Geological Society, Berlin, November 5th, and the University of Toronto, February 8th, 1864, and a photograph of Mr. Fraley for the Album.

Donations for the Library were received from the Vaudois Society of Sciences, and the Museum at Cambridge, Massachusetts.

An obituary notice of Dr. Darlington was read by Mr. T. P. James.

AN OBITUARY NOTICE OF DR. WILLIAM DARLINGTON,

Read before the American Philosophical Society, February 19th, 1864, by Mr. T. P. James.

The usual reproach charged upon scientific men, of unfitness for the duties of practical life, cannot be urged against the subject of this sketch, for versatility of talents, joined with great executive ability, caused his opinion to be eagerly sought for, and his judgment highly valued.

William Darlington in early life had few educational advantages; possessing, however, energy of character and great perseverance, he was enabled by his fondness for study to enrich his mind with lore from the writings of the best authors in most of the ancient and modern languages. He had the rare faculty of improving every

opportunity for acquiring knowledge; his childlike humility was apparent even in advanced age, and he never felt himself too old to learn or too wise to accept the gleanings of other minds.

When we consider his kind and benevolent disposition, social habits, and genial manners, it is not surprising that his loss is deeply mourned by numerous friends, and a large circle of acquaintances and correspondents, not only in this country but in Europe.

He was elected a member of the American Philosophical Society forty years ago, and was among the oldest surviving members. His life-long devotion to science and important public services have rendered his name honored and his memory deserving a tribute of respect.

Our attention will be chiefly directed to his character as a botanist, for it is that side of his full-orbed life which is most interesting to us, and by which he has been most widely known.

Some knowledge of his history and early life may be gleaned from the following extract from a manuscript autobiography in my possession, and will serve to illustrate the preceding remarks:

"My great grandfather, Abraham Darlington, was a contemporary of William Penn; and being of the same religious persuasion, followed him to his province of Pennsylvania near the close of the seventeenth century.

"He first settled near Chester, a village on the right bank of the River Delaware, and the oldest town in Pennsylvania. His letters from his parents in England are dated from Darn Hall in Cheshire. He afterwards removed to the banks of the Brandywine, our classical stream in Chester County, where he continued to reside until his death. His son Thomas, my grandfather, married Hannah Brinton, the daughter of a Quaker family, which also came with William Penn. Their eldest son, Edward Darlington, my father, was married to Hannah Townsend, daughter of another old English family of Quakers, which had sought a refuge in Penn's province.* I was born on the 28th day of April, 1782, and so far as I can trace my

* It would not be inappropriate here to allude to an occurrence of recent date, the sesqui-centennial gathering of the clan Darlington, which rallied at East Bradford, Chester County, the residence of Brinton Darlington, grandson of the first American progenitor, on the 20th August, 1853, at the call of some of the elders of the tribe, where nearly four hundred, old and young, assembled at the appointed time and enjoyed the happy reunion. On which occasion it was ascertained that the total number of descendants of Abraham Darlington amounted to one thousand five hundred and twenty-four.

ancestry on both sides, I may say that my blood is purely Anglican, without a cross.

"My father inherited a farm from his maternal grandfather. It is situated in the Township of Birmingham, five miles south of West Chester, about midway between the two localities on which the battle of Brandywine was fought. On that farm I was born and brought up until I nearly completed my eighteenth year. I was the eldest son, and being designed for a farmer, I was put to all sorts of agricultural labor as I became capable of it. I was not permitted to go to school, except in the winter season, after I was thirteen years old; and yet I manifested at an early age a much greater fondness for books than hard work!

"My mother taught me to read while I was quite young; and I recollect often hearing the dear old lady tell the neighbor women that her Billy had read the Bible through before he was six years old.

"Before I was eighteen I had conceived such an aversion to the uninteresting drudgery of the farm, and felt such a desire to engage in some kind of study or scientific pursuit, that my father consented to let me study medicine, which was the profession I selected, on account of its connection with the most interesting natural sciences.

"Accordingly, on the 1st of April, 1800, I commenced the study of medicine, in Wilmington, Delaware, with Dr. John Vaughan, a respectable physician of that place. In the autumn of that year I began the study of the French language with an accomplished scholar.

"In 1802, I became conscious of a taste for botanical researches, which was awakened by the perusal of Darwin's Botanic Garden, but there was no one then in Wilmington to aid me, and I made little progress. In the autumn of that year, Wilmington was visited by the malignant yellow fever; such was its mortality and the consequent dismay, that all the physicians, except my preceptor, ingloriously fled; he, and I, his humble student, were the only medical personages who staid to attend the sick; we persevered through an arduous and anxious season, and were mercifully favored to escape the disease.

"In November, 1802, I repaired to Philadelphia, to attend the medical lectures in the University of Pennsylvania, where I was favored to become familiarly acquainted with Prof. B. S. Barton, who discovering in me a considerable fondness for the study of plants, took me under his special patronage, and by his kind attention and instruction gave a decided bias to my future pursuits. A society was

formed that winter, called the American Linnæan Society, of which Prof. Barton was president, and it did me the unexpected, not to say unmerited honor, of enrolling me among the members.

"At the conclusion of the course of lectures, I returned to the office of my preceptor in Wilmington, where I passed the summer in his service, but in the following November, went again to Philadelphia, to attend my second course. I became a member of the Philadelphia Medical Society, and applied myself diligently to prepare for the degree of Doctor of Medicine, being the first candidate from Chester County, so far as I know, who had then aspired to that honor.

"I passed a satisfactory examination for my degree, in March, 1804, and as the commencement that year did not take place until the beginning of June, I remained in the city to prepare and print my inaugural thesis, and especially to attend a course of lectures on Botany, by Prof. Barton.

"The Professor occasionally took his small class to the Bartram Botanic Garden, to illustrate practically some of his teachings, and these were my earliest visits to that interesting spot. William Bartram and John Bartram, Jr., were then living there, and distinctly do I recollect the venerable men, though I little dreamt I should one day have so much to do with the history of the family.

"The candidates for the medical degree of Doctor were publicly examined before the Trustees and Faculty of the University, on the merits of their several Theses.

"The subject of mine was, the 'Mutual Influence of Habit and Disease.' It fell within the province of Prof. Rush to examine it. As I had the good luck to advocate the favorite doctrines of the Professor in that essay, I got off very handsomely. Instead of putting me on the defensive, as several of my companions had been, the Doctor called me up, and addressing the Trustees and Faculty said, 'This dissertation, gentlemen, is a successful application of metaphysics to the practice of physic. I have read it twice through with attention, and have no objection to make to it.' I then had nothing to do but make my bow and sit down. A very talented gentleman from Virginia, vastly my superior, who sat immediately before me, and had just been severely questioned on some of the doctrines of his thesis, turned round and laughingly asked, 'Darlington, is that what you call defending your thesis?' On the following day I received my diploma, and returned to my father's dwelling to reside, after an absence of four years. Here I loitered away my time in a

limited country practice, and in the study of Latin, for, when I received my diploma, I could not read a word of it, and my pride was piqued and my ambition excited to get rid of that opprobrium. I took lessons of a private tutor for a few weeks, and then set to work myself until I made considerable progress. Thus I passed my time for two years, moping in rural solitude over my grammar and dictionary, when not riding to see a patient; but I became discontented with my humdrum existence as a country practitioner, and at length resolved to abandon my rustic home for a life of more excitement and interest. I therefore engaged myself as surgeon of an East India ship bound to Calcutta. After a long and tedious voyage of five months in a leaking ship we landed safely at Calcutta. I went ashore to reside, and being curious in the study of language, I procured a grammar and forthwith commenced the acquisition of the spoken jargon, as it is termed, of Bengal. We remained two months in port, during which time I spent two delightful days in the East India Company's Botanic Garden, and made the acquaintance of Dr. Wallich, its director, the well-known botanist. After an absence of thirteen months I reached my native land."

Some years after his return, he prepared, from his journal and memory, an account of his India voyage, in a series of letters from Calcutta, which may be found in the 13th and 14th volumes of the Analectic Magazine.

Dr. Darlington in his younger days was a man of social habits, and a cheerful companion in the several societies of which he was a member, and much given to poetry and rhyming. Many of his songs were written for the amusement of his associates, and, as he had a good voice, were always sung by him with eclat. A number of these rhymes found their way to the public in the periodicals of the day.

On the 1st of June, 1808, he married Catharine, daughter of General Lacey, of New Jersey, an officer of the Revolutionary War, and settled in West Chester, at that time a small hamlet, to practise medicine, in which pursuit he was successful, and maintained a high position in the profession. For self-improvement he studied the German language under a private tutor, and soon acquired a knowledge of German literature.

In 1813, he began to devote more especially his leisure hours to botanical investigations, with a view of preparing a catalogue of the phænogamous plants growing in the vicinity of West Chester, but his peaceful occupation was interrupted by the war then raging with Great Britain, and although educated in the tenets of the Society

of Friends, he became imbued with the spirit of a soldier and actually took up arms in defence of his country, and rose to the rank of major of a regiment. Having acquired a military taste, he aided in keeping it alive among his associates. A few years later he was elected a lieutenant colonel of a battalion of volunteers, and afterwards colonel of a regiment, and commanded the escort to General Lafayette on his visit to Chester County and the battle-fields of the Brandywine. During his military ardor his muse took a patriotic flight, and his effusions were much in vogue in those stirring times, and served greatly to elicit enthusiasm among the yeomanry of Chester. Their gatherings were elivened with many of his songs.

While serving in the field he received notice of his election to the national legislature. Soon after taking his seat as a member of the 14th Congress, he composed and sung, at a dinner given on the 8th of January, 1816, by the Pennsylvania delegation, to Commodores Decatur and Stewart and Captain Biddle, of the Navy, the "Yankee Tars,"—a song commemorative of our naval victories, and historic of the deeds of the brave men of that day. This song was published in the leading journals, and received merited encomiums.

Dr. Darlington was re-elected a member of Congress in 1818, also in 1820, and ever faithful to his trust, was rarely absent from his seat.

He made a memorable speech in favor of restricting slavery in the State of Missouri, as preliminary to her admittance as a member of the Union, which was published in the National Intelligencer, and in Niles's Register, where he remarks, it is preserved "like a fly in amber." This speech did infinite credit to his head and heart, and was a subject on which he ever felt strong convictions of the truth of his views.

In recent exciting events he took a lively interest, and at the outbreak of the rebellion his loyalty to the Union was strongly manifested, in bringing his entire influence to bear in upholding the position of the Government, and he remarked, that had he been younger, he would again have unsheathed his sword in defence of his country.

In the summer of 1817 he began in earnest to prepare his work, and at the suggestion of his friend, Dr. Baldwin, to collect an herbarium of the plants of Chester County, as an indispensable means of determining the species; but his attention was much diverted from a vigorous prosecution, by various trusts and public services. Still, his duty to his first love would prevail, and lead him back to his agreeable labor.

Although he commenced the Enumeration in 1813, it was not fully elaborated for the press until the winter of 1824–25. Its issue was retarded, in the meantime, on account of the appearance of Pursh's valuable Flora, and subsequent publication of Nuttall's excellent work on the North American Genera, but more especially of Dr. Barton's Flora Philadelphica, which latter comprised the greater portion of the plants of his district; all seeming to him to supersede the utility of his project, and, for a time, he relinquished the idea of printing the work.

Believing, however, in the good results of local Floras in the development of science, he brought his labor to a close.

In the ardor of the pursuit of his object, he had the satisfaction of communicating a taste for botanical investigations to a number of the intelligent gentlemen of his vicinity, who, in return, afforded him assistance in his work.

The Enumeration was published under the title of "Florula Cestrica." The motto adopted for the work, a line from Horace, is characteristic of the author,—"Ore trahit quodcunque potest atque addit acervo."

In 1837 he published the Flora Cestrica, a more extended work, being an attempt to enumerate and describe the flowering and filicoid plants of Chester County, Pennsylvania, adopting the Linnæan arrangement, whilst the modern botanical world had so generally abandoned it for the natural method. He considered the latter as yet not sufficiently established in its details for his purposes, although freely admitting that the true science of vegetables could only be attained by a philosophical investigation of their structure, functions, and natural affinities; yet he could not help thinking that even the superficial knowledge of genera and species so readily acquired by the Linnæan system, of advantage to the learner, by exciting an early interest and facilitating his first steps. Of this edition, it must be admitted, that a more comprehensive description of each species of a genus has rarely been given to the public in this country.

A third edition of the Flora Cestrica appeared in 1853, arranged throughout according to the natural system, to which was added those plants which had been found to exist in the County since the preceding one was published, and it was extended so as to embrace the Anophytes and the Thallophytes. The author contemplated, when this revised edition was commenced, to have inserted a brief description of all the indigenous species of the Vegetable Kingdom which had been detected in the County, together with such introduced

plants as had become naturalized, or were cultivated for useful purposes, but it became apparent that the still lower orders, especially the Fungi, which are so multitudinous, would render the volume inconveniently large.

Of this work, we have the highest authority for asserting that it is "one of the best local Floras ever written." It has become a handbook for all lovers of the "amiable science" in his native State, and the clear and minutely accurate descriptions of the plants enumerated, will always render it a valuable assistant to the botanist.

Dr. Darlington was so strongly impressed with the great importance of a knowledge of botany, to almost all classes of the community, that he let no opportunity pass without expatiating upon its advantages; he regarded its utility great, in reference to mental discipline, intellectual qualification, and practical usefulness. He seemed to think it impossible for any one endowed with the common attributes of humanity to avoid being, to a partial extent, at least, a naturalist; in his opinion, no education could be deemed complete without some acquaintance with the rudiments or first principles of botanical science, some rational knowledge of the multiform creation around us, known as the Vegetable Kingdom. To the agriculturist, he considered such information indispensable; and with these views, he compiled and published, in 1847, an Agricultural Botany, an enumeration and description of the useful plants and weeds which merit the notice or require the attention of American farmers. The beneficial influence of the circulation of this useful volume in Chester County is evident from the disappearance of those pestiferous weeds which have followed the footsteps of civilization from the old world to the new. In compiling this work, he found it somewhat difficult to determine, satisfactorily, the line of demarcation between plants entitled to a place, and those which might properly be omitted; but it must be admitted that he has happily succeeded in the selection of plants for the object he had in view.

In 1819 Dr. Darlington opened a correspondence with the veteran botanist, Prof. De Candolle, of Geneva, and sent him a package of American plants, which procured him a polite return, and doubtless, in 1824, the honor of a genus dedicated to his name; this genus was afterwards found, by Mr. Bentham, to be a Dismanthus, and so it was cancelled.

Many years later, Dr. Torrey, unwilling that the labors of this Nestor of American botanists should not be suitably commemorated,

at first indicated a genus to his name of a Californian plant on imperfect specimens, but upon obtaining good flowering plants, it proved to be only a species of Styrax. (Styrax Californica, n. sp.)

Nothing daunted, however, Dr. Torrey determined that there should be established a genus suitable to such an honor, and seized the opportunity of dedicating a new pitcher plant, detected in Upper Sacramento, California, which proved to be generically distinct from Sarracenia, as well as Heliamphora, and which he remarks, "I take pleasure in dedicating it to my highly esteemed friend, Dr. William Darlington, of West Chester, in Pennsylvania, whose valuable botanical works have contributed so largely to the scientific reputation of our country." And thus it now stands firmly established, the *Darlingtonia*, with one species thus far known, the *Californica*. He was very desirous of seeing a living specimen of this plant, but his wish was not gatified; he, however, had the satisfaction of knowing, a few days prior to his decease, that Dr. Gray had succeeded in raising a plant from seed, at the botanic garden at Cambridge.

Dr. Darlington projected a Natural History Society, which, in conjunction with a few friends, was organized on the 18th of March, 1826, by the name of the Chester County Cabinet of Natural Science, to which institution he was elected president, filling that office during his life. For thirty-seven years he labored assiduously for its welfare, devoting much time and energy by addresses and writings to awaken a general interest in the subjects connected with it. Drawing around him a few congenial spirits, he hoped to illustrate thoroughly the natural history of his native county, taking for his model White's History of Selborne, which he particularly admired. This plan has been partially carried out, and collections made, but only the botanical portion has been published.

He bequeathed to this institution his valuable library of botanical books and his Herbarium, containing the treasures of his life-long labors in that science. This he rearranged only a few years ago, adding the synonymes of each plant, thus facilitating the research of future botanists. He asserted that its eight thousand species were so completely catalogued and arranged according to their natural affinities, that any one of them could be promptly exhibited on demand.

He was chosen President of the Chester County Athenæum, in 1831, and by his services rendered that institution valuable assistance.

Making the acquaintance of a Castilian gentleman, residing in

West Chester, in 1832, he studied under his instructions the Spanish language, and took delight in perusing many works of celebrity in that tongue.

Dr. Darlington's interest in the botanists of his native State, induced him to compile selections from the correspondence, with occasional notes and a biographical sketch of his intimate friend and classmate, the late William Baldwin, M.D., Surgeon in the United States Navy, who died whilst on an expedition up the Missouri, under Major Long, which he published in 1843, under the title of Reliquiæ Baldwinianæ.

A few years afterwards, from the materials put into his hands, he collected the correspondence of two of the early and venerable pioneers of botany in Pennsylvania, to which he appended a brief notice of the life of each, and published them in 1849, in one large volume, as the Memorials of John Bartram and Humphry Marshall, with notices of their botanical contemporaries.

In these worthies of a former generation he was deeply interested, and alluded to himself with his usual humility of his own name going down to posterity as an epiphyte clinging to their sturdy branches. Much credit must be accorded to him for the patient perseverance in rescuing from oblivion these very interesting letters, many of them written by the most distinguished European botanists of Linnæus's time, and comprising some of the epistolary correspondence of the two venerable Pennsylvanians, and which the editor persuades himself that the lovers of nature and admirers of native worth amongst us will regard with interest.

Humphry Marshall, it is believed, published the first truly indigenous botanical essay in this Western hemisphere. It appeared in the year 1785, in the form of a duodecimo of about two hundred pages, under the title of Arbustum Americanum, the American Grove, and is dedicated to the officers and members of the American Philosophical Society.

Among Dr. Darlington's contributions to the history of his native State must be mentioned an interesting paper on the famous "Mason and Dixon's line." He has given an excellent account of this memorable controversy between Lord Baltimore and the family of Penn, which lasted from 1682 to 1767.

From his untiring research and extreme accuracy in detail, he was well fitted for an antiquarian, but the ever-open book of nature, whose hieroglyphics he tried to elucidate and expound, had higher claims to him than old manuscripts and musty tomes.

During the last few years of his life he was engaged in preparing the "Notæ Cestrienses," a series of memoirs of the men of Chester, published in a periodical of the county. He left in the hands of his friend J. Futhey Smith, voluminous MS. materials for the history of Chester County, which it is to be hoped will be speedily published.

His last work, completed a few months before his death, was a paper on "The Weeds Injurious to Agriculture in the United States," for the Agricultural Bureau, and will appear in the next volume of reports.

At the organization of the Chester County Medical Society in 1828, although he had relinquished the practice of medicine for nearly twenty years, yet such was the estimation he was held among the profession, that he was elected president, which position he held at his death.

In 1848, the degree of Doctor of Laws was conferred on him by Yale College; and he was a member of more than forty literary and scientific societies.

To exhibit Dr. Darlington's comprehensive talent, it would be proper to state that he took an active part in establishing the Bank of Chester County, and was continued a director from its origin until his death, and president for more than thirty years. He held various appointments from the Governor, Prothonotary of the County, Canal Commissioner, and for a term President of the Board. He was the prime mover in establishing the Agricultural and Horticultural Societies of the county, and the West Chester Railroad, and for a time a Director and President of the Company. In fact, every public improvement projected within his native county or town, appears to have originated with him, or found in him an active coadjutor. He took great pains in securing beauty of design and symmetry of form in the public buildings of West Chester, and a prominent part in the improvement of the public park, selecting the trees with care, and planning this small arboretum, which in time will be the resort of those who wish to study the form and growth of our native trees.

Dr. Darlington held during his life many important political offices, and the following remark in his biography, merits the attention of office-seekers of the present day. "I have been some ten years in public service, by election and executive appointment, and can truly say that I never asked for an office; nor as much as insinuated to any one that I would like to have his vote and interest for one. I always took it for granted that every man who wished to vote for me would do so without solicitation; and if he did not wish it, I was too proud to solicit it."

He was ever ready and always disposed to contribute to the advancement of any literary or scientific enterprise by public addresses and lectures, and he was frequently called upon for such gratuitous labor. More than twenty addresses, mostly upon botanical science or kindred subjects, were delivered by him, on various occasions, and afterwards published. His constant desire was to educate the public mind to a love of scientific pursuits, he therefore lost no opportunity of communicating his own zeal to the young around him.

In the spring of 1862, Dr. Darlington was attacked by paralysis, from which he partially recovered, but the following winter another stroke rendered him helpless, and he gradually declined, until the 23d of April, 1863, when he quietly expired at the advanced age of nearly eighty-one, in the town of West Chester, and only a few miles distant from his birthplace.

Twenty years before his death, he wrote his own epitaph, as he remarks, in his biography, "I had a desire to prevent the partiality of surviving friends from resorting to commonplace cemetrical eulogy, and yet had a wish for some botanical allusion, to meet the eye of any lover of plants who might happen to visit the spot while the memorial remained, so I prepared the following, which is intended as the expression of a kindly wish or ejaculation on the part of the future botanist who may see and recite it as he rambles by. It is to be an isolated paragraph below the name and dates, thus:

PLANTAE CESTRIENSES,
QUAS
DILEXIT ATQUE ILLUSTRAVIT,
SUPER TUMULUM EJUS,
SEMPER FLOREANT !"

His remains repose in a secluded part of the beautiful Oaklands Cemetery of West Chester, to which they were borne by a crowd of his sorrowing neighbors, on the Sunday following his decease. He was mourned not only as a public benefactor, but as a friend, kind, affectionate, and charitable, a consistent communicant of the Episcopal Church, a truly Christian gentleman, in whose death each felt a personal loss. A wise man, his literary attainments and learning were never obtrusively thrust forward; the humblest listener separated charmed by his simplicity of manner and quaintness of conversation: thus he made friends of all, yet in his quiet dignity he seemed the

father and patriarch of the beautiful town he had for fifty-five years watched over, and with which his name will ever be identified.

I will close this tribute to a tried and faithful friend with a quotation he has on a like occasion adopted.

—— "Manibus date lilia plenis:
Purpureos spargam flores, animamque Amici
His saltem accumulem donis, et fungar inani
Munere."

"Handfuls of fresh and fragrant lilies bring,
Mixed with the purple roses of the Spring:
Let me with funeral flowers his body strew;
This mournful duty to my friend I owe,—
This unavailing gift at least I may bestow."

A letter was read from Prof. Zantedeschi, of Padua, dated January 7 6, 1864, offering for publication in the Transactions of the Society an Italian manuscript, entitled "Capo III. Dei risultamenti ottenuti da uno nuova analisi dello spectro luminoso," which on motion of Prof. Coppée was referred to a committee, consisting of Prof. Kendall, Prof. Lesley, and Dr. Bridges.

A communication was read from Mr. Buckingham Smith, dated New York, February 15th, 1864, addressed to Mr. John W. Field, 243 South 18th Street, Philadelphia, and communicated to the Society through Mr. Benjamin Gerhard, offering for publication by the Society a communication entitled "Grave Creek Mound, and certain Inscriptions on Stone, found in the Northern Atlantic States, incidental to its History," which was read by the Secretary, and after remarks by Dr. Coates, Prof. Trego. Dr. Le Conte, and Prof. Haldeman, was on motion referred to a committee consisting of Prof. Haldeman, Mr. Chase, and Dr. Le Conte.

Prof. Haldeman presented a curiously formed pebble, taken from the bottom of an excavation in the Valley of the Susquehanna, to illustrate the very artificial aspect which purely natural objects of this kind sometimes wear.

Mr. Chase referred to a paper on caloric, lately published by Mr. Colburn, and discussed its bold but violent hypothesis of the generation of the diurnal maximum of heat from the conversion of the earth's rotary velocity. Mr. Briggs

and Prof. Cresson continued the discussion, by reference to Tyndall's observations on the heat-absorbing capacity of aqueous vapor, furnishing, in fact, the only sound basis for explaining the variations of the daily climate.

The minutes of the Board of Officers and Members in Council were read.

Pending nominations 508, and new nominations 509 to 518 were read.

The bill of Pawson & Nicholson was referred to the Committee on Finance.

The Library Committee reported as follows:

At an adjourned meeting of the Library Committee, February 19th, 1864, the resolution offered at the stated meeting of the Society, October 2d, 1863, and referred to the Library Committee to report thereon, was considered, and on motion of Mr. Price the following resolution was offered to the Society, viz.: *Resolved*, That the Catalogue, as far as printed, be distributed to such as agree, by subscription, to take the whole volume of three parts, at the price fixed upon by the Society, payable when the second part shall be delivered. On motion the resolution of the Committee was agreed to by the Society.

The Society was then adjourned.

Stated Meeting, March 4, 1864.

Present, thirty-four members.

Dr. Wood, President, in the Chair.

Prof. Chase, a recently elected member, was introduced to the President, and took his seat.

A letter acknowledging the receipt of publications was received from the Natural History Society of Newcastle on Tyne, dated February 4th, 1864.

A letter respecting transmitted manuscripts was received from Prof. Zantedeschi, dated February 7th, 1864.

A letter requesting an exchange of publications was received from the Imperial Library at St. Petersburg, dated January 10–22, 1864. On motion, the Imperial Library was ordered to be placed on the list of correspondents.

A letter from Dr. Leidy to the Secretary, dated Philadelphia, February 23d, 1864, was read and referred to the Curators for action.

A letter from Prof. Haidinger to the Secretary, dated Vienna, February 9th, 1864, was read, inclosing a list of contributors to the Von Martius Festival Medal. On motion, the list was ordered to lie on the table, to afford members an opportunity to subscribe.

Donations for the Library were announced from Prof. Zantedeschi, the Royal Astronomical Society, the Essex Institute, the Academy of Natural Sciences at Philadelphia, Dr. B. H. Coates, Senator Wilson, and the National Observatory.

Photographic portraits of Leo Lesquereux, Isaac Lea, and Elias Durand, members, were presented for the Album.

The death of Prof. Edward Hitchcock, a member, at Amherst, Massachusetts, on the 27th ult., aged 70 years, was announced by the Secretary.

The Committee to which was referred the paper on Grave Creek Mound reported against its publication and were discharged, their report having been accepted and approved.

The report of the Board of Secretaries on the communication received from the Royal Society, was, on motion, adopted, as follows: 1. That they are prepared to furnish to the Royal Society a supplementary list of American Journals and Societies to complete their catalogue of scientific memoirs. 2. That they recommend to the Society to offer to prepare, at the expense of the Royal Society, a catalogue of papers contained in such volumes of said list as the Royal Society may indicate.

Dr. Cresson exhibited his improved magnifying and polarizing oxyhydrogen apparatus. On motion of Dr. Bache, the thanks of the Society were presented to Dr. Cresson for the

pleasure and instruction he had given to the members by this exhibition.

Mr. Lesley drew the attention of the members present to the beautiful recent microscopical investigations of Prof. Sorby into the metamorphic condition of rocks.

Mr. Chase referred to the communication which he had made at the last stated meeting, and made further remarks respecting the alleged connection between the variable rate of the earth's rotation and the mean temperature of given parts of its surface.

Mr. Colburn's inquiry into the nature of heat suggests some interesting speculations concerning other effects of rotation than those that can be measured by the barometer. Recognizing the impossibility that the sun should warm the whole solar system, as a simply incandescent body,—the improbability that its heat should result from continuous combustion, and the probable approximate uniformity of temperature in the upper regions of the atmosphere, in summer and in winter, by day and by night, Mr. Colburn looks for the principal sources of heat in the earth itself. He supposes, 1, that the solar attraction tends to draw into closer proximity the particles of air on the heated side, and to separate them on the night-side of the earth, thus producing heat of compression, and cold of expansion: 2, that the change of eastward velocity from 69,000 miles per hour at midnight, to 67,000 miles at noon, (*sic*) necessarily produces a conversion of motion into heat, and of heat into motion: and 3, that if the earth is moving in a resisting medium, by which it is so retarded that it approaches the sun at the rate of 1,000,000 miles in 3,000,000 years, its "lift" involves the annual abstraction of a heat-force equiva lent to 752,665,108,390,000 horse-power!

The third hypothesis has been often broached; the indications of a resisting ether, which, as we have seen, are furnished by the hourly barometric means, may, perhaps, yield the data for its final verification or rejection. The supposed separating effect of the sun's action in the most remote portions of the atmosphere, is so problematical that it seems hardly deserving of any consideration, and even if it existed, it is difficult to understand how it could produce a difference of more than a fraction of a degree in the range of the thermometer. The alternate acceleration and retardation of orbital velocity, can produce no *accumulation* of heat to supply any

loss that may arise from radiation into space, but it must modify the *distribution* of heat throughout the day in a manner that may be readily calculated. The available data are not sufficient to furnish us with complete results, but they give curious approximations that seem to open a wide field for profitable investigation.

"Sir John Herschell finds the direct heating effect of a vertical sun at the sea level to be competent to melt .00754 of an inch of ice per minute, while according to M. Pouillet, the quantity is .00703 of an inch."* Taking the mean of these two estimates (.00728 in.), multiplying by the latent heat of water (142.6° F.), and dividing by the number of cubic inches in 1 lb. of water (28), we obtain $\frac{.00728 \times 142.6}{28} = .037076$ units of heat received per minute on each square inch of the earth's surface that is exposed to a vertical sun. The weight of the aerial column being 15 lb., and its ratio of specific heat 25, the maximum effect of the direct solar rays is sufficient to heat the whole atmosphere $\frac{.0371}{15 \times .25}$ per minute, or 7.12° F. in 12 hours.

Now, in consequence of the earth's rotation, the difference of atmospheric "lift" between noon and midnight, is 182,336 ft. per minute. The average difference for the twelve hours, is one-half as great. "Rapid rotation, without friction or resistance, cannot in itself alone be regarded as a cause of light and heat;"† but we have found in our barometric investigations, that the ratio of the half-daily velócity of rotation to that which would be conferred by twelve hours' action of terrestrial gravity, is .00109, which may be regarded as the modulus of heat-producing resistance. If we multiply the average difference of lift by the weight of the atmosphere, and by the effective resistance, dividing the product by the ratio of specific atmospheric heat, and the number of foot-pounds raised by a unit of heat, we obtain $\frac{91168 \times 15 \times .00109}{770 \times .25} = 7.74°$ F. as the amount of heat communicated to the air by rotation between midnight and noon, and abstracted between noon and midnight.

The theoretical barometric lift is, as we have seen, .00219 of the entire weight of the atmosphere. Estimating the height of the aerial column when reduced to uniform surface density, at 24,000

* Tyndal, Heat considered as a Mode of Motion. N. Y. edit. p. 431.

† Dr. J. R. Mayer.

feet, the heat-producing disturbance that is indicated by the barometer, is represented by a lift of 15 lb. on each square inch to a height of $.00219 \times 24000$ ft. The quarter-daily disturbance from this cause is, therefore, $\frac{24000 \times 15 \times .00219}{770 \times .25} = 4.1° F.$

It is more than likely that each of these results will require important modifications when the entire influence of the several conditions of the problem is better understood. I have thought it proper to present them in their present crudity, in order to show the true points of departure, and to prepare the way for some further considerations.

Whatever other heat-disturbing causes there may be, there can be little doubt that the three we have just been considering are the most important. Dividing the astronomical day into four quadrants, and representing the solar effect by S., rotation by R., and barometric by B., it will be readily seen that the several positive and negative influences must be distributed as follows:

	S.	R.	B.
From 0h. to 6h.	+	—	—
" 6h. to 12h.	—	—	+
" 12h. to 18h.	—	+	—
" 18h. to 0h.	+	+	+

The tables of average temperature at any given place would therefore furnish us with four equations for determining the value of each of the disturbing elements, provided those that are unknown were so insignificant as to be safely neglected. The effects of these unknown disturbances are confined within certain limits that can be pretty satisfactorily determined.

Our discussion of the barometric fluctuations demonstrated a tendency of inertia to retard the effects of rotation, so that the mean daily altitudes are found nearer to 1h., 7h., 13h., and 19h., than to 0h., 6h., 12h., and 18h. A like tendency is discernible in the thermometer.

There are three, and only three, quadrantal divisions of the day, commencing respectively at 0h., at 1h., and at 2h., for which we could obtain approximate positive values of S., R., and B. The maximum solar effect is deduced from the first, and the minimum from the third of these divisions; while the maximum rotative and barometric effects are exhibited in the third, and the minimum in the first division.

The nearest average temperatures are found in the third division, as is shown below.

Average of temperature at 2h., 8h., 14h., and 20h., and of the entire day.

Station.	Mean of the four hours.	Daily mean.
At Girard College, . .	52°.1	52°.1
At St. Helena, . . .	61°.65	61°.69

The following table presents all the co-ordinate positive values of S., R., and B., that can be obtained from the Girard College and St. Helena means.

Station.	Dividing at								
	0, 6, 12, 18h.			1, 7, 13, 19h.			2, 8, 14, 20h.		
	S.	R.	B.	S.	R.	B.	S.	R.	B.
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Girard College, . .	45.92	41.32	12.76	31.3	49.5	19.2	13.8	63.2	23
St. Helena, ...	25.97	42.96	31.07	15.8	46.7	37.5	5.6	56.6	37.8

The percentages of the calculated values correspond very nearly with the means of the earliest Girard College and St. Helena values.

	Calculated values.	Percentage.	Mean Percentage.	Limits.	
S., . . .	7°.12	37.6	35.95	5.6	45.92
R., . . .	7°.74	40.8	42.14	40.8	63.2
B., . . .	4°.1	21.6	21.91	12.76	37.8

It may be inferred from this comparison, that the rotation element of daily heat is least affected, and the solar element most affected by extraneous causes, (of which moisture is probably the chief); that the first division gives the best, and the third division the poorest results; that the proportion of thermometric variation which is attributable to rotation is between .4 and .5 of the average total daily variation, and that the most difficult element to determine satisfactorily is S., which is modified by many local disturbing influ-

ences, such as the nature of the soil, amount of vapor, clouds, altitude of the sun, &c. &c.

Pending nominations, Nos. 508 to 518, and new nomination No. 519, were read.

On motion of Mr. Peale the following resolution was considered and adopted: *Resolved*, That the Curators be authorized to make such selection as they may deem proper, of articles from the Cabinet of the Society, and place them at the disposal of the Chairman of the Committee on Curiosities, Relics, and Autographs, for the Sanitary Commission, as a loan for exhibition during the ensuing fair.

And the Society was adjourned.

Stated Meeting, March 18, 1864.

Present, twenty-three members.

Judge SHARSWOOD, Vice-President, in the Chair.

Prof. William D. Whitney, a recently elected member, was introduced to the presiding officer and took his seat.

Letters announcing the transmission of publications were received from the Royal Academy at Lisbon, dated November 25th, 1863, and from the Engineer Department at Washington, March 17th, 1864.

Donations for the Library were announced from the Royal Academy at Lisbon, the Royal Society at Edinburgh, the British Meteorological Society, the Annales des Mines, the Boston N. H. Society, the Franklin Institute, Messrs. Blanchard and Lea, and the Engineer Department of the United States.

On motion of Mr. Barnes, Dr. Goodwin was appointed to prepare an obituary notice of the late President Hitchcock.

The Secretary read a letter from Prof. Wilson, of Toronto, offering for sale a new copy of the "Birds of Australia," costing originally £150, and never yet taken from its case.

Mr. Lesley presented for the Cabinet, a specimen ball of sea-grass, and described the manner in which multitudes of similar balls, of all sizes, are manufactured by the waves, upon the shores of Nice.

Mr. Lesley then read a communication, which he had received from Mr. R. Pearsall Smith, of Philadelphia, in reply to inquiries, which he had made, respecting the published county maps of the United States.

His own attention had been called to the subject anew, and very forcibly, by the difficulties he had lately encountered in obtaining a map of Cumberland County, at the county seat, Carlisle. At the last invasion of the State, preceding the battle of Gettysburg, the advance guard of the rebels swept the Great Valley clean of all its county maps; those of Franklin and those of Cumberland. The same fate befell those of Adams County. For a day or two, not a map of the seat of war was to be obtained at Harrisburg for the use of the Governor and his staff. General Couch had but a single copy at his headquarters. An order on Philadelphia could only be filled by sending out a special agent, who succeeded, at great personal risk, in procuring one or two of each county. Judge Watts, of Carlisle, informed me that the maps were torn hastily from the walls of the farmers' houses, and sent with the horses and other valuables for safety, over the North Mountain, into the Juniata Valley. The rebel visitation was very complete; he thought it likely that not a single house had been overlooked. The sack of the Valley would have been most disastrous, but for the want of rolling stock on the railroad. What they carried off was on their backs. The two engines and trains which took the Pennsylvania troops up to the front at Chambersburg, were telegraphed back so exactly at the right time, that they had passed Scotland Station but four minutes before the Rebel cavalry dashed in from the south to cut them off.

A rebel general is understood to have made a reconnoissance of these counties previous to the invasion under the guise of a map-peddler, and while selling some of a more general character, no doubt bought up county maps to be used in the invasion.

It is known that the bureau at Washington was robbed of many unique county maps before the rebellion broke out. When General McClellan advanced upon Richmond, but one copy of the map of Henrico County could be procured. The rebel leaders had secured,

also, all but one or two copies of Loudon and Jefferson and the few other Virginia counties of which maps had been executed. General Crawford informed me that on his advance to Culpeper, he was fortunate in securing two beautiful manuscript maps of that county; but for the long campaigns in Virginia, the utmost annoyance has been experienced for the want of maps. The mountain country of Virginia has never been mapped, with even the most distant approximation to topographical truth. The mountains of East Tennessee do not form so complicated a system as those of Western Virginia, but no map of their features worthy of the name is in existence yet. Even the large sheets of the seats of war issued for pressing and popular need from the United States Coast Survey Office, can scarcely effect a reduction of the principal errors. Nor can that mountain belt be mapped except by topographical geologists, on the plan pursued by the geologists of the Pennsylvania survey. It is to be hoped that on the return of peace, this greatly desired contribution to science, the extension of the Pennsylvania Appalachian Topography southward, will be made, and with an advantage not enjoyed by those who did the work in Pennsylvania, namely, with well-constructed county maps, done with an odometer, like those of the Northern States.

The number of these Northern county maps is now very great. Mr. Smith has kindly colored for me a map of the United States, to

show the parts covered by these odometer surveys. They are 300 in number. They have formed the basis of the recently published and very correct State maps of New York, Pennsylvania, and New Jersey.

But as the editions of the county maps are always small, seldom exceeding 1000 copies, and after one or two dozen extra copies have been struck off for the publisher, the stones are always destroyed, they go out of the market, and become extremely difficult to procure. In important cases special agents have to be despatched to the locality to purchase copies from the walls of the farmers' houses, at a high price.

It would be natural to expect to find complete sets of the county maps of each State in the archives of its capitol. Strange to say, none such is known to exist except at Albany. Stranger still, no set of these maps, no record of all this labor done, is to be seen at the Capitol of the Nation, neither in the Library of Congress, nor in the Bureau of the Interior, nor at the Bureau of the Coast Survey. A few of them, the number amounting perhaps to one-twentieth of the whole, are on file in the Engineer Department of the United States. And yet every day diminishes the chance of making up such a set. Within the last two months the editions of thirty have been exhausted.

In striking contrast to our own conduct, the British Government has possessed itself of a complete set of American county maps, by giving a standing order for each, as it appears, to be sent to the British Museum. Recent orders to send "everything in the map way relating to the United States," took the last copies of the twenty rarest of these county maps.

For eighteen years, this slow discussion of the boundaries, streams, roads and houses of the surface of the United States, has been carried on by Mr. Smith* and others, with a continually improving organization, and increasing rapidity, until about two-thirds of the well-settled North has been delineated. The fieldwork seems rude to the physicist, engaged in discussing the figure of the earth, and to the chief of a survey of an arc of a meridian. But the results are perfectly satisfactory to the naturalist, the county surveyor, the soldier, and the geologist. The latter finds his canvas ready prepared, and can lay in his picture with comfort and success. When larger areas are to be mapped, then astronomical determinations and trigonometrical adjustments come in place. But the compensations which rectify magnetic work in the field, by skilled hands, carefully plotted afterwards in the office, produce results which favorably compare with the most careful triangulation; and at all events may, if the needs of society call for it, precede, in order of time, just as well as follow, the application of the more accurate methods of the science.

* R. Pearsall Smith, 517 Minor Street, Philadelphia.

Mr. Fraley spoke to the same subject, describing the early history of the efforts made by citizens of Pennsylvania to obtain an improved State map, and the desirableness of an accurate astronomical and trigonometrical determination of the principal points of the surface. He suggested the expediency of the Secretary preparing, for the next meeting of the Society, the draft of a memorial, which may be presented to the Legislature, during its present session.

Pending nominations Nos. 508 to 519, and new nominations Nos. 520, 521, were read.

The Chairman of the Board of Curators presented the following report, as ordered at the last meeting.

HALL OF THE SOCIETY.

At the last stated meeting, a letter from Dr. Leidy was read, containing a copy of a resolution unanimously passed by the Academy of Natural Sciences, at the meeting of the 23d ultimo, in the following words:

"With the view of facilitating the study of archæology, *Resolved*, That the specimens of antique art, belonging to the Academy, be deposited in the Museum of the American Philosophical Society, provided they shall be returned, on demand, and that the Curators of the Society shall give a receipt for the same to the Curators of the Academy."

The Curators of the Society have given due consideration to the resolution quoted, and are of opinion that it is highly expedient that the deposit should be accepted, and the specimens of the Academy be added to the collection of the Society, already embracing a considerable number and variety of articles of the "stone age" of this country, and a magnificent collection of those of Mexico and Peru, &c.

The Curators are impressed with the conviction that it is incumbent upon the Society to lend their fostering countenance to this department of science, particularly as there is no institution in the city or State which has paid any attention to the subject, or afforded any facilities for its study or development.

With these views, the Curators beg leave to offer the following resolutions:

1. That they be authorized to receive the deposit of the Academy, and to give the required receipt for the same.

2. That they be authorized to exchange such duplicate specimens

On account of the mutual dependence of all the forces of nature, and the reasonableness of Prof. Faraday's conjecture, that they are often, if not always, convertible more or less into each other,* it seems probable that the disturbances of the magnetic needle may be as closely connected with the earth's rotation, and the continually changing position of each point relatively to the sun, as those of the barometer and thermometer. Ampère held that the earth is an electro-magnet, magnetized by an electric current from east to west, the current being excited by the action of the sun's heat successively on different parts of the earth's surface as it revolves toward the east. The friction of trade-winds and ocean-currents and the variations of light and temperature that are produced by rotation and orbital revolution, must exert an influence upon the magnetic needle, and beside these indirect effects, M. Arago showed that simple rotation, in some unknown way, produces magnetism in bodies of every description. Many have supposed that this magnetism is derived from the earth by induction, but on account of the impossibility of escaping from the influence of terrestrial magnetism, it is difficult to obtain any conclusive evidence on the subject.† A similar impossibility has interfered with Prof. Faraday's endeavors to connect gravity and magnetic or electric action by experimental results. The probability of such a connection has been shown by the electricity developed in the dry pile of De Luc, and by Gen. Sabine's observation, that when the sun and moon were on the meridian the magnetic variation reached 5°, but when they were in quadrature, it fell as low as 20'.‡

The great forces of nature can be measured only by their disturbances or their deviations from uniformity. The action of gravity is so nearly uniform at all times and in all parts of the globe, that it is difficult to imagine any crucial experiment that could demonstrate its relations to magnetism. Perhaps a needle, hinged at its point of support, with the two extremities nicely balanced, might help us towards such a demonstration, if careful experiments were tried, to show the relative influence of gravity upon each extremity, both before and after magnetizing, and when subjected to artificial magnetism, so as to produce various amounts of deviation from the normal dip and declination. Or, centrifugal force, so applied as alternately to assist and oppose the effects of gravity, as in large fly-wheels revolving with various degrees of rapidity, may indicate variations of

* Phil. Mag. 4th Ser. 1, 68.

† See correspondence of M. J. Nickles, Silliman's Journal, v. 17, p. 117, &c.

‡ Silliman's Journal, vol. 19, p. 424.

wards made the property of the Society by the liberality of Mr. Poinsett.

The resolution of Mr. Peale was then adopted.

And the Society was adjourned.

Stated Meeting, April 1, 1864.

Present, nineteen members.

Dr. Wood, President, in the Chair.

A letter of acknowledgment was received from the Liverpool Literary and Philosophical Society, dated February 29, 1864.

Letters of envoi were received from M. the Minister of Public Instruction, dated Paris, November 21st, M. Hector Bossange, dated Paris, February 25, and the Liverpool Literary and Philosophical Society, dated March 17, 1864.

Donations for the Library were announced from M. Troyon of Lausanne, the London Reader, the Literary and Philosophical Societies of Liverpool and of Quebec, Silliman's Journal, the Academy of Natural Sciences, Professor J. C. Cresson, and Dr. Kirkbride of Philadelphia.

The death of Dr. Franklin Bache, at his residence in Spruce Street, on Saturday evening, the 19th ultimo, aged 71 years, was announced by Mr. Fraley, with a feeling tribute to his venerated character and long and varied relations to the Society. On motion of Mr. Fraley, the President, Dr. Wood, was requested to prepare an obituary notice, to be read before the Society.

Mr. Chase continued his remarks upon heat and afterwards illustrated the polarizing action of muscular energy by a magnetic needle held in the hand, but explained the phenomenon as due chiefly, if not solely, to a law governing the mechanical propagation of vibrations.

On account of the mutual dependence of all the forces of nature, and the reasonableness of Prof. Faraday's conjecture, that they are often, if not always, convertible more or less into each other,* it seems probable that the disturbances of the magnetic needle may be as closely connected with the earth's rotation, and the continually changing position of each point relatively to the sun, as those of the barometer and thermometer. Ampère held that the earth is an electro-magnet, magnetized by an electric current from east to west, the current being excited by the action of the sun's heat successively on different parts of the earth's surface as it revolves toward the east. The friction of trade-winds and ocean-currents and the variations of light and temperature that are produced by rotation and orbital revolution, must exert an influence upon the magnetic needle, and beside these indirect effects, M. Arago showed that simple rotation, in some unknown way, produces magnetism in bodies of every description. Many have supposed that this magnetism is derived from the earth by induction, but on account of the impossibility of escaping from the influence of terrestrial magnetism, it is difficult to obtain any conclusive evidence on the subject.† A similar impossibility has interfered with Prof. Faraday's endeavors to connect gravity and magnetic or electric action by experimental results. The probability of such a connection has been shown by the electricity developed in the dry pile of De Luc, and by Gen. Sabine's observation, that when the sun and moon were on the meridian the magnetic variation reached 5°, but when they were in quadrature, it fell as low as 20'.‡

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* Phil. Mag. 4th Ser. 1, 68.

† See correspondence of M. J. Nickles, Silliman's Journal, v. 17, p. 117, &c.

‡ Silliman's Journal, vol. 19, p. 424.

magnetic influence, that can be explained only by the conversion of gravity into magnetism or the reverse.

Prof. Faraday, in a lecture before the Royal Institution in the year 1857, endeavored to show that our usual conception of gravity is not in harmony with the principle of "conservation of force." Prof. Brücke* and others, have tried to remove the difficulties in which the question is involved, but I believe none of the proposed solutions have been satisfactory to the learned philosopher who first started the discussion.

It has even been questioned whether gravity can be properly called a force, or whether it is anything more than a simple "tendency." Prof. Brücke has shown conclusively, that it is subject, like heat and other recognized forces, to all the laws which regulate the interchange of *actual* and *potential* energy; and our barometrical investigations furnish a beautiful illustration of the manner in which its tension is balanced by opposing forces.

We speak, indeed, of weight, as if it could be predicated only of bodies at rest, and as if it were so entirely distinct from momentum that no comparison could be properly instituted between the two. Precisely the reverse is true. Absolute rest is apparently an impossible condition of matter, for, to whatever extent the action of opposing forces may be relatively neutralized, the inconceivable rapidity of æthereal, planetary, and stellar motions, produces a constant change of place. Even if we confine our attention to the earth alone, in each instant (dt), every particle has a tangential motion (tan. $d\theta$), and a central motion of gravity (sin. $d^2\theta$) that constitutes a *vis viva* which we call its weight, and which is in equilibrium with the elasticity of the molecular æther. The sum of all the instantaneous energies is the same, whether the particle fall freely for any given time, or remain apparently at rest. All the potential energy which is transformed in one case into the actual energy of motion,† in the

* Phil. Mag., 4 S., 15, 81.

† The potential energy of gravity is represented by $g = 32$ ft. per second. The earth's rotation allowing only about $\frac{1}{290}$ of this amount, or .1107 ft. per second, to be converted into actual energy, the remainder must be employed in overcoming molecular elasticity. The formula $a = \left(\frac{gt^2r^2}{4\pi^2}\right)^{\frac{1}{3}}$ gives 26,221 miles as the radius of the sphere of attraction that is in equilibrium with the molecular elasticity at the earth's surface. These opposing forces must produce constant oscillations, and by the study of these oscillations, it may perhaps be possible to reconcile the several hypotheses of Newton, Faraday, Mossotti, and Challis, respecting the nature of gravitation. See Phil. Mag., 4 S., v. 13, p. 231-7, and v. 18, p. 447, sqq.

other is counteracted by an equivalent and opposite central energy of elasticity. Therefore, when we compare the relative effects of rotation and gravity, it is immaterial whether we use as the measure of force, the integral of the *vires vivae*, or the respective amounts of motion that the two forces would produce, if they were able to act freely for the same time. The difficulty of determining the repulsion of molecular elasticity precluding any satisfactory use of the former measure, I employed the other, and the precise accordance of the results thus obtained, with the results of observation, justified the correctness of the hypothesis, in the same manner as the accurate computation of planetary motions has confirmed the Newtonian theory of gravity.

Gravity, therefore, with the same propriety as heat, may be considered as a "mode of motion," whether acting merely as "dead weight," or as an accelerating or a deflecting force. If it can be shown that magnetism also originates in motion, we may be able to demonstrate the mutual convertibility that Faraday suspected.

The earliest hypothesis with regard to terrestrial magnetism looked for its cause to a powerful magnet, lying nearly in the line of the earth's axis. Subsequent discoveries led to a modification of this view by the supposition of another magnet, pointing towards the Siberian pole. Mr. Barlow's idea, that the magnetism is superficial and induced,* has now been generally adopted, and if it could be shown that solar or rotary action is capable of developing magnetism in particles such as those which are known to constitute our globe, the gréat difficulty in the way of a satisfactory explanation would be removed.† Ampère's, Barlow's, and Christie's experiments showed that simple rotation is sufficient to affect the magnetism of a compass-needle,‡ and in the oxygen of the atmosphere, which, as Faraday discovered, has a specific magnetism, variously estimated at from $\frac{1}{882}$§ to $\frac{1}{287}$‖ of that of iron, we have a medium through which any induced magnetism may be distributed over the entire surface of the earth. Some simple experiments that can be easily repeated, seem to confirm Ampère's views, and to indicate the manner in which the circulating electric current is excited.

* Phil. Trans., 1831.

† Enc. Brit., Art. "Magnetism."

‡ The effect of rotation on the magnetic needle may be shown in a rough way, by causing an ordinary grindstone to revolve rapidly, and bringing a compass near its edge.

§ By M. Becquerel.

‖ M. Plücker.

There is a species of mechanical polarity, of which I have never seen any notice, that is apparently produced by motions resembling those to which the air is continually subjected. It may be exhibited in the following ways:

1. In the middle of a basin of water, lay a long strip of any substance (floating it by corks or otherwise, if it is heavier than water). After the water has become still, lift the basin carefully by one hand, and hold it at arm's length. The intermitting muscular action produces longitudinal vibrations, which tend to bring the floating strip into a line with the outstretched arm, and the tendency may be increased by moving the basin gently up and down.

2. Hold the gimbals of a binnacle compass so that it can swing only in one direction, and cause it to move like a pendulum in that direction. The needle will tend towards the line of oscillation. Vessels may have been lost from ignorance of this fact, for it is not unusual for compass pivots to become so worn that the needle moves sluggishly, and in order to start it, the compass-box is shaken. If one of the gimbal hinges should be rusty, the shaking would bring the needle into a line perpendicular to the axis of the free gimbal, and the captain might easily suppose that he was sailing north, when his course was due east or west.

3. Take an ordinary pocket compass, grasp it firmly between the thumb and finger of one hand, and move it quickly up and down through a small arc. The needle, as in the last instance, will tend towards the plane of motion. This experiment may be variously modified, according to the length and directive energy of the needle, the steadiness of the operator's nerves, &c. Sometimes a simple grasp, with a powerful muscular contraction, will bring the needle into line, without any other vibration than that which arises from the irresistible nervous tremor. Sometimes the momentum acquired by each pole in its approach to the operator, carries it forward so as to bring the other pole under the wave-influence, and the needle is thus made to rotate so rapidly as to become nearly invisible.

The polarity in each of the three cases here enumerated, is easily explained upon purely mechanical principles, but there are some indications that seem to show a close connection between the mechanical vibrations and those of nervous electricity. There appears to be a great difference in the control of different individuals over the needle. Some can bring it into line at once, with scarcely any perceptible motion, while others are obliged to use considerable effort; the needle does not seem at all times equally susceptible; it often

appears more easy to produce rotation in one direction, than in the other. There may, therefore, be a natural connection between these experiments and those of M. Du Bois Raymond, who attached two strips of platinum to a very delicate galvanometer, and caused them to dip into two cups of salt water. Dipping the fingers of each hand into the cups, and alternately bracing the muscles of each arm, he produced a perceptible deflection of the needle. MM. Becquerel and Despretz repeated the experiment without obtaining very satisfactory results, but M. Humboldt was more successful.* Add to these phenomena the well-known evidences of a constant current, circulating around magnets, and if we suppose that electricity consists simply of vibrations, it will seem perfectly natural that the magnet should obey the strongest vibrations.

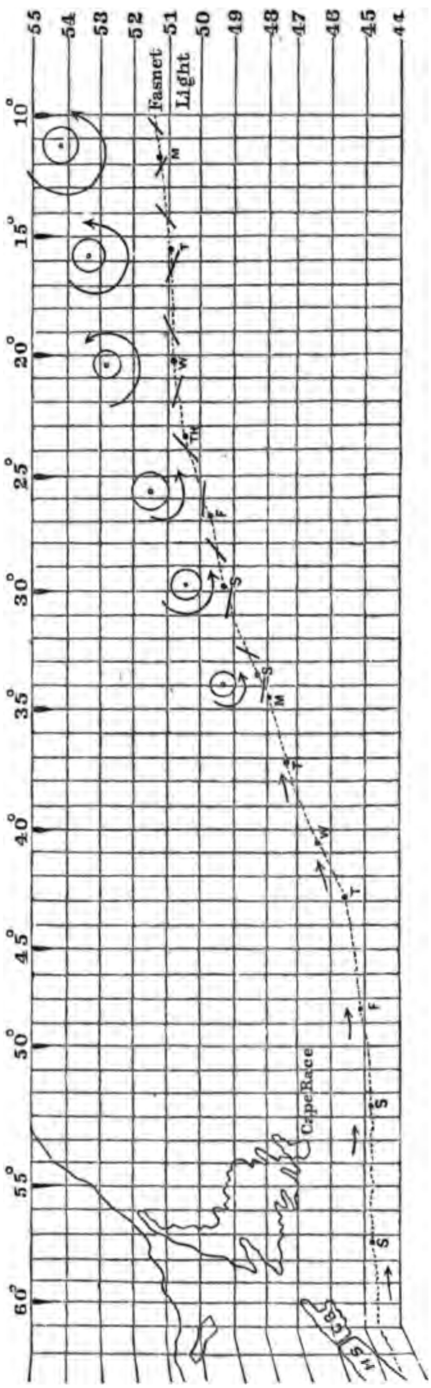
Mr. Briggs exhibited a suite of specimens, to illustrate the steps of the new process by which non-resinous woods are converted into paper pulp, by the application of soda at high temperatures.

Dr. Emerson embraced the opportunity to describe the successful performance of the new machines, now employed in cleaning out flax fibre for market, with little or no loss in the form of tow, the flax, thus obtained, commanding a market value three or four fold that of the seed; so that it has been stated that a profit of $400 per acre of flax-sown ground has been realized. The machine has three sizes and forms, and may be called the cotton gin of the North. Mr. Briggs explained how much of the superiority of the Irish linen depended on the perfection of the rotting process carried forward under the regular humid climate of Ireland, and considered it improbable that any successful competition could be made in America, until some artificial chemical process shall be discovered applicable to the case, like the hot soda process, which he had described in connection with wood fibre, and by which fine cotton-like flax had also been produced, a specimen of which he exhibited.

Mr. Lesley described the succession of gales encountered by the B. M. S. S. Canada, on her hundredth and longest voyage, from Liverpool to Boston, between the 11th and 21st of January, 1864.

* See Silliman's Journal, vol. 8.

The steamer left Liverpool, with fair weather, on the 9th, and encountered a smart blow in the Irish Channel, but ran along the Irish coast in fair weather, touched at Queenstown for the mails, and passed Fasnet Rock Light in the night of Sunday, January 10th. It began to blow from the westward here, and continued to blow from that quarter, dead ahead, with variable violence, until Thursday night, January 21st. The steamer reached Halifax, in the face of light west winds, Monday evening, January 25th, and Boston, Wednesday afternoon, January 27th, after a voyage of *nineteen* days.



The accompanying woodcut shows the course of the steamer and her position each noon between Fasnet Light and Halifax. In the first eight days, that is to say, from Sunday noon to the second following Monday noon, the Canada encountered six distinct gales, the sixth and last raging through Sunday night with such violence that the steamer could barely be kept to the wind; and the officers asserted that no sailing vessel could have lived.

At the beginning of each gale, the wind came *from*

the southwest; and at the close, from the northwest; but in neither case from more than a few points to the north or south of the magnetic west. There were but two hours during the whole voyage during which the wind blew from any point east of south. At the extreme of violence for each gale the wind blew dead ahead. During the intervals of a few hours between the gales, the sky would clear, and the wind come quietly in from the west, until its shifting to the southwest gave the signal for the opening of the next blow.

The barometer fell rapidly and low at the beginning of each gale, and rose more slowly afterwards. If Captain Galton's hypothesis of a reversed descending cyclone to accompany a rising barometer after the direct ascending cyclone with a falling barometer, be intended to apply to all atmospheric disturbances, small as well as large, some exhibition of this supposed phenomenon should have been made by this series of gales. (Phil. Mag. No. 174, p. 225, Proceed. R. S., December 18th, 1862.) "It is hardly possible," he justly urges, "to conceive masses of air rotating in a retrograde sense in close proximity, as cyclonogists suppose, without an intermediate area of direct rotation, which would, to use a mechanical simile, be in gear with both of them, and make the movements of the entire system correlative and harmonious." But we have this very conception realized before our eyes, habitually, in every series of eddies on the surface of a stream. If the cyclonal columns were stationary and contiguous, some intermediate disturbance, analogous to a pinion between two cogs, must occur; and if the interval have a diameter equal to that of each cyclonal column, the disturbance might perhaps assume a simple reverse columnar form and motion at its circumference, opposed as they would be by the vertical stability of its axis. But if the two supposed stationary verticals were nearer than one diameter, the disturbances of the interval must become very complicated, and hardly recognizable on a chart by any simple system of curves.

But as, in fact, cyclonic columns, such as those under discussion, have a forward slip, like the eddies in water, the line of motion of any particle of one column (or of its observed base) is by no means in the curve of a volute; but, like the path described by a particle of the earth's surface in its course round the sun, approximates a straight line, oscillating from side to side without an epicycle. If, therefore, in a series of cyclones of retrograde projection, the intervals were filled with other cyclones of direct projection, there could be no concealing the fact; and at least traces of such an interval

system would have appeared in the log-book of the Canada, in the voyage under discussion.

Such a waved line crossing and recrossing the wake of the Canada, twelve times in eight days, would graphically represent the forward movement of the winds encountered. Theoretically, it would represent one of two things: either, 1st, a horizontal libration of the fronts of successive masses of condensed atmosphere moving magnetic east, or north of east; a supposition which I imagine no meteorologist would accept for a moment; or, 2d, a system of curves belonging to the southern sides of six small cyclones, following each other along a line not quite parallel to the course of the ship, and to the north of it, close to it at the western end, and diverging from it eastward.

I say *small* cyclones, because when we landed at Halifax the inhabitants spoke with delight of the lovely weather the people of Nova Scotia and Newfoundland had been enjoying for more than a fortnight. A glance at the map will show, therefore, the small radius to be ascribed to the gales through which we had been fighting slowly our way. We must consider it therefore probable that these gales, however vortical in build, belong to a different system of disturbances from the periodical storms of immense radial sweep which travel along the Atlantic coast inland in the same direction.

The next important point to be observed, is the fact of the sudden commencement of the system on the west, at longitude 45° west from Greenwich, that is, where the ship's course ran out of the Gulf Stream and approached the Banks. That we did not cut across the axis of the system, is plain, from the fact that no *southeast* or *northeast* winds were encountered. Otherwise it would be easy to consider this system of gales as attached by some law to the northern margin of the Gulf Stream, at least as to their common axis of forward movement. But unless the series of gales had exhausted itself precisely at the moment when we reached longitude 45°, or actually commenced at that longitude, it must be allowed that the Canada then and there sailed *under* the system; which, in that case, must be regarded as descending from some region to the southwest, and in the upper strata of the atmosphere, and impinging at that point upon the surface of the sea, thence, continuing forward, at that level, to the coast of Ireland.

Whether this be the best view or not, it is remarkable that these violent disturbances are popularly confined to one particular season of the year. Captain Moody, on consulting the record log-book of the

steamer, found that the next longest voyage of the Canada had been its first. He stated that all the voyages from Liverpool to New York, commencing about the 9th of January, were longer and stormier than the others. In 1863 the corresponding voyage made by the Europa had been one of 21 days. That of the America in 1862 had also been one of 21 days. The succeeding voyage is always considered a good one, not as against a prevalent west wind, but as against gales.

The *average* time of endurance of each gale was 26 hours, and the average interval of comparative calm was 6 hours. If 60 miles an hour were given as the speed of the wind, and this were considered to mark the speed of the vortical column, we would be obliged to consider the distance between the centres of the gales as about 2000 miles, and there could have been but one gale traversing at any one time the distance between the Banks and Ireland. There would be sufficient room, therefore, for it to assume any magnitude, however great. But the fair weather on the British provincial coast, as has been already said, seems to prove the small diameter of all the gales, and we must view each one, therefore, as making its solitary journey, as a simple eddy, nearly along the northern margin of the Gulf Stream, and probably enlarging its area as it advanced; which would account for the extreme violence of the gales we encountered last as compared with those encountered in the first part of the voyage.

But of course, the rate of motion of the nucleus cannot be fairly represented by the rate of motion of *any* given circle on its limb, unless that particular circle be selected at just the proper distance from the centre, to be a mean between the dead wind at the extreme circumference and the excessively rapid rotation at the centre. In some one of these gales, it is probable, that the ship's course did cut such a circle of mean motion, and got (without, of course, knowing it) the exact rate of the vortical, in the actual rate of the blast over the deck. It is a great mistake to draw a vortical storm with the shape which it would have if it had no body-movement forward and moved in vacuo. The fact must be, that most of the sections of a cyclone move forward with its nucleus in nearly parallel lines; and that the storm as a whole, while theoretically vortical, is in practice linear. It practises its gyrations only near its centre.

The form of such a gale, moreover, must be merely a form, like the form of a wave, the vortical movement being impressed on successive portions of air, which, after being in turn set moving, are in turn allowed to stop, fall into the rear, and come to rest.

Mr. H. S. Eaton remarks, in his paper on the antagonism of the polar and equatorial currents (Art. xli, Proc. B. Met. Soc., June, 1863), that "from some years' study of cyclonic storms and their courses Europewards, he should say that the greater proportion of these circular storms traverse the Atlantic in zones, parallel somewhat to the dotted line on his map of the great storm of the 18th and 19th of May, 1863, their course, however, varying according as the sun is north or south of the equator, their course being more *northerly* as the sun approaches the tropic of Cancer, and more southerly as it recedes therefrom." The line he draws, is one almost parallel to the course of the Canada after leaving the coast of Ireland, or about S. 20° W. (true). The coincidence of this course with that of the axis of the Gulf Stream after leaving the Banks, is a marked feature. No one yet, to my knowledge, has thoroughly discussed the action of the mass of air warmed, and no doubt also propelled in that direction, by the moving surface of the Gulf Stream, upon the wall of colder air to the north of it, and the vault of cold air overhead; yet we have in their apposition and reaction a cause of great and regular disturbance. Even if the mass of cold air to the north must be regarded as moving in the same direction, the different rates of the two movements, and the perpetual struggle of the lower part of the northern mass to inflow, and of the warm mass to uprise, must produce complicated movements of great regularity, and in the main vortical in a retrograde sense.

Admiral Fitzroy considers that he has established the occurrence of cyclones of destructive violence but limited area, originating locally in the vicinity of the British Islands. Are we then to look for such a spontaneous origination of vortical disturbances at any point along the track of our cyclones between America and Great Britain, or are they confined in their origin to the vicinity of land?

The principal points of interest, are the rate of the cyclones by which their relative distances might be measured, and the question of their generation about the 45th degree of west longitude, or their descent at that meridian from the upper regions of the atmosphere over the Atlantic seaboard States.

Pending nominations Nos. 508 to 521, and new nomination No. 522 were read.

Resolutions recommended by the Publication Committee, for the purchase of old copies of exhausted editions of the Transactions, old series, for the printing of No. 1, and title-

page of Vol. 1, of the Proceedings, and for providing a cover for future numbers of the Proceedings, were adopted.

On motion, Mr. Price, Mr. Fraley, and Mr. Colwell, were appointed a committee to take into consideration and report at the next meeting upon the subject of providing a lot for the future building of the Society.

And the Society was then adjourned.

Stated Meeting, April 15, 1864.

Present, fifteen members.

Dr. Wood, President, in the Chair.

Letters acknowledging the receipt of publications were received from the Natural History Society of Nuremberg, November 14th, and the Royal Society at Upsal, September 15th, 1863.

Letters of invoice were received from the Imperial Society of Naturalists at Moscow, September 6–12; the Royal Society at Upsal, October 15th; the Royal Society at Berlin, November 30th; the Royal Society at Stockholm, November 18th; the Royal Society at Munich, November 20th, 1863.

Donations for the Library were announced from the Royal Academies and Societies at Stockholm, Upsal, Moscow, Berlin, and Munich; the Geological Society at Berlin, the Natural History Society at Nuremberg, and the Zoological Society at Frankfort on the Maine; the Bureau of Public Instruction at Paris; MM. Desnoyers and Boucher de Perthes, Prof. Hennessy, Blanchard & Lea, and the Rev. Mr. Barnes, of Philadelphia.

Donation for the Album, from Mr. Isaac Lea, of the portrait of Dr. George Jager.

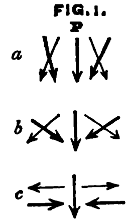
On motion, the Natural History Society of Nuremberg was placed on the list of correspondents to receive the Proceedings.

Mr. Chase made remarks upon the subject of magnetism, and in further illustration of what he had advanced at previous meetings.

Barlow's and Lecount's laws for the distribution of the induced magnetism in masses of iron, are precisely the same as would follow from the relative centrifugal motions of different portions of the earth, provided the magnetic axis coincided with the axis of rotation. It is therefore reasonable to presume that they accurately represent the superficial motions or currents on which the magnetism depends, and to hope that a careful study will enable us to detect the cause of the oscillations that polarize the air and all other bodies that are capable of vibrating in harmony with it.

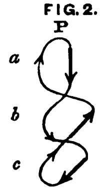
If the earth were stationary, the sun's heat would produce a constant ascending current over the whole meridian, which would be supplied by colder lateral currents from each side. These currents are represented in Fig. 1. P, is the pole; E, the equator; *a*, *b*, *c*, the lateral currents. The light arrows represent the direction of the upper, overflowing, warm air, and the dark ones the direction of the lower, cool air. The effect of these several currents would be a mechanical atmospheric polarity, precisely analogous to that which was indicated by our experiments upon the control of the magnetic needle by mechanical vibrations.

FIG. 1.



In consequence of the earth's rotation, the tendency shown in Fig. 1, is communicated only at the instant of noon. At all other times, the flow of the cool air towards the equator, and of the warm air to the coldest portions of the globe, is modified by the earth's motion, so as to produce currents analogous to those represented in Fig. 2. P represents, in this instance, not the true pole, but the point of greatest cold. The warm air rises at E, and flows towards P until it becomes sufficiently cooled to sink to the earth. Still flowing onward it absorbs the heat of the earth, until it is so rarefied as to rise again. This process of alternate rise and fall, is continued until the air reaches P, and then returns by the same law and in a similar manner, to E.* These currents, which are flowing at all hours, and in

FIG. 2.



* Halley, in 1686 (Phil. Trans., No. 183), explained the trade wind, and the necessity of a reverse upper current, but he found it "very hard to conceive why the limits of the trade wind should be fixt about the 30th degree of latitude

all portions of the earth, produce an atmospherical directive energy towards the poles of maximum cold, which appear, according to Sir David Brewster, to coincide with the magnetic poles.

Now, if we consider that in addition to these permanent currents, there is a continual motion of silent convection, the warm air rising, and the cold air descending in parallel columns, like the particles in a vessel of boiling water,* and if we remember that the warm air is charged with moisture which is condensed as it ascends, parting thereby with much of its heat and electricity, we can hardly deem it necessary to adopt Dr. Dalton's hypothesis that ferruginous matter is the source of atmospheric magnetism. Still the existence of vaporized iron in the air undoubtedly contributes an increased intensity to the magnetic currents, and it may probably be an important agent in the production of magnetic storms.

The two vibratory systems represented in Figs. 1 and 2, are conjoined during the hours when the sun is above the horizon, and the laws of motion applicable to the first system correspond precisely, as we shall see hereafter, with the laws of the solar-diurnal variation deduced from General Sabine's admirable discussions of the St. Helena observations. It is not so easy to explain in its minute details the comparatively insignificant lunar-diurnal variation, but I am convinced that the aerial currents produced by lunar attraction, will sufficiently account for all the magnetic influence that is due to the moon exclusively. The changing barometric pressure, and the deposition of dew during the night, modify these currents in such a way as to disguise the simple effect of any slight disturbing cause; nevertheless, there is a manifest tendency underneath all the disguise, to maxima and minima at the precise hours when they ought to occur in consequence of the moon's attraction.

In the influence of the violet rays upon magnets, the connection of the violet rays with the tension of brass in the polariscope, the excitement of magnetic vibrations in iron by percussion and torsion, the increase of magnetism by cold and its diminution by heat, and the

all around the globe." I am not aware that any one has ever pointed out the combined effects of convection, absorption of heat from the earth, and the daily superposition of the currents represented in Figs. 1 and 2.

* It is very probable that this motion of convection is a more important agency than has generally been supposed. If we close the lower drafts of a common air-tight stove, and open a register immediately over the fire, the cold air does not rush directly to the draft pipe; but it falls with great velocity to the surface of the fuel, as may be shown by dropping pieces of paper through the register.

general correspondence between Challis's laws of molecular action and the laws of attraction and rotation, we may find interesting evidences of the unity of force which all modern discovery tends to demonstrate, and in that unity a sufficient explanation of the observed annual and secular variations of the magnetic needle, the disturbing magnetic effects of auroras and solar spots, the changes of the wind, and storms of every kind. Some of the well-known phenomena of storms furnish a ready test of the principles I have attempted to establish.

Although Fig. 2 represents the general tendency of a particle of air, it is not probable that all the atmosphere, or even, perhaps, any considerable portion of it, follows so regular a path. In the upper regions, where the air is not so much affected by the radiation of the earth, it may oscillate, as suggested by Redfield, "from centrifugal action towards the equator, and gravitation towards the poles,"* and between the points of decussation there are undoubtedly eddies which have a general movement eastward or westward, in accordance with the theory of M. Dové. These several currents are represented in Fig. 3. The disturbances of the æther, dependent upon the relative attractions of the earth and sun, probably produce tides corresponding in time with those of the barometer, which must modify the atmospheric currents. The character of these disturbances may be inferred from Fig. 4, the horizontal arrows representing the course of the æther under the solar influence, and the curved arrows its course under the combined attraction of the earth and sun.

FIG. 3.

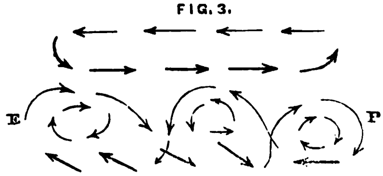
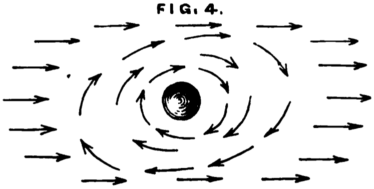


FIG. 4.



Having thus ascertained the causes and directions of the principal normal currents, the ordinary theory of winds enables us to understand the effect of mountain peaks, deserts, forests, rivers, and ocean-streams. Every point of the earth's surface that accumulates or radiates an undue amount of heat, becomes a centre of polarity with an attractive energy that disturbs the atmospheric equilibrium, tending to produce wind and rain. If the disturbance is confined to a

* Silliman's Journal, vol. 25, p. 130.

limited area, there is a well-known cyclonic tendency, the portion of the eddy which is nearest the equator, *generally* flowing eastward. Mr. Galton* has ingeniously shown that in descending cyclones, the direction may be reversed, and I should expect a similar reversal to be of frequent occurrence in the neighborhood of some of the powerful ocean-currents, at points where they tend to produce backward eddies. Such points are found midway between the Sandwich Islands and California, about 35° west of Chili, near the west coast of New Holland, in the Indian Ocean, northeast of Madagascar, and in other places.

The effect of ocean-currents in producing cyclones, and directing their course, is well illustrated by the repeated observations that have been made in the Gulf Stream. Prof. Lesley's interesting account of the series of storms encountered by the Canada on her one hundredth voyage,† exhibits the natural consequences of the friction of two belts of air at different temperatures, moving in opposite directions. The warm air over the Gulf Stream, and the cold air over the Arctic currents that flow nearer to the American continent, are both borne very nearly in their normal directions, but with the approach of winter their parallelism becomes almost vertical, the cold belt becomes wider from its encroachment upon the land, and the vortices that arise from their concurrence are frequently brought down to the surface of the ocean, instead of taking place in the higher regions of the air, as they usually do during summer.

While sudden, violent tempests that are occasioned by local disturbances over a limited area, are almost necessarily cyclonic, I am inclined to adopt Espy's theory with regard to long storms, that usually "the wind will blow in towards a line rather than towards a point," and in favor of this hypothesis as well as of the periodicity of weather-changes, I would suggest the following explanation.

The normal currents of the atmosphere (Figs. 2, 3) are subject, as we have seen, to a daily disturbance by the sun's action (Fig. 1). This disturbance, like the moon's tidal action, is cumulative, and has a constantly increasing tendency to overcome the aerial polarity. The gathering wave follows the sun until it is saturated with vapor, and as soon as it becomes powerful enough to influence the normal current, it must produce a shifting of the wind, and a deposition of moisture. The equilibrium of temperature is then restored, to be subjected anew to the same constant disturbance and the same stormy culmination.

* Phil. Mag., Sept., 1863.

† Proc. Amer. Philos. Soc., April 1, 1864.

[My attention has just been called by the last number of the Journal of the Franklin Institute, to some extracts from the London Athenæum for January, announcing a paper on Magnetic Storms, which was read by Mr. Airy before the Royal Society. I take this early opportunity to acknowledge that the Astronomer Royal appears, in some measure, to have anticipated the views upon the sources of terrestrial magnetism, which I have recently had the honor of communicating to the Philosophical Society.

As I have not yet seen the paper in question, I do not know how far the priority may extend; whatever may be its limits, it gives me pleasure to yield my claims to so distinguished and cautious an investigator, and to find that my own independent conclusions have been so ably corroborated. And I believe I have good grounds for hoping, that in the specific solar action which I have pointed out, Mr. Airy will find the precise "occasional currents produced by some action or cessation of action of the sun," for which he is looking. May 14.]

Mr. Peale made a communication on stone implements.

Pending nominations, Nos. 508 to 522, and new nominations, No. 523, were read, and the Society proceeded to ballot for members.

Mr. Fraley, on behalf of the Committee on the purchase of a building lot, reported progress.

All other business having been transacted, the ballot-boxes were opened by the presiding officer, and the following persons were declared duly elected members of this Society.

Benjamin V. Marsh, of Philadelphia.
James T. Hodge, of Newburg, N. Y.
James Kirchhoff, of Heidelberg, Germany.
Francis J. Pictet, of Geneva, Switzerland.
Benjamin Studer, of Zurich, Switzerland.
Alphonse Count de Gasparin, of Paris.
Peter Tunner, of Leoben, in Styria.
M. Thury, of Geneva, Switzerland.
Rev. Dr. Tholuck, of Halle-an-der-Saale.
Carl Schinz, of Offenburg, Baden.
William Sellers, of Philadelphia.
Richard S. Smith, of Philadelphia.
Alexander Wilcocks, M.D., of Philadelphia.

And the Society was adjourned.

Stated Meeting, May 6, 1864.

Present, seventeen members.

Judge SHARSWOOD, Vice-President, in the Chair.

Letters accepting membership were received from William Sellers, dated Philadelphia, April 26; from Alexander Wilcocks, dated Philadelphia, May 2; from R. S. Smith, dated Girard College, May 4th; and from Benjamin V. Marsh, dated Philadelphia, May 4, 1864. Mr. Marsh, Mr. Sellers and Dr. Wilcocks were presented to the presiding officer and took their seats.

Letters respecting the exchange of publications were received from O. Böhtlingk, of the Royal Academy of St. Petersburg, and from Henry St. John Maule, of the Agricultural Society at Bath, dated December 31st, 1863.

On motion of the Librarian, the request of the latter was ordered to be granted.

A letter was read from Sig. Zantedeschi, dated Padova, March 28, 1864, respecting his previous communications, requesting the publication of his letter of January 6th, as follows:

Alla Celebre Societa' Filosofica Americana in Filadelfia.

Cotesta illustre Societa' Filosofica gentilmente m'invitava ad inviarle il mio ritratto fotografato, essendosi essa proposto di formare un Album dei Membri della medesima. Io non mandrero' di adempiere a questo suo desiderio, che e' un onore per me, entro il prossimo venturo Marzo, nel quale potro' far eseguire la fotografia di due tavole risguardanti i miei esperimenti e le mie ricerche sullo spettro luminoso. Di queste e di altre fu eseguita nel 1846 una edizione di pochissimi esemplari che non fu messa in commercio librario, e quindi ora irreperibile. In tali esperimenti trovansi parecchie verita' o scoperte che ora si attribuiscono ad altri fisici. Credo di non fare cosa discara alla Societa' rassegnandogliene del Capitolo III che tratta dell' analisi dello spettro solare una copia manoscritta, perche possa avere l'onore di essere pubblicata negli Atti della Societa'. Sara questa pubblicazione un' immagine scientifica che si riflettera' ovun-

que giungano gli Atti importantissimi di cotesto insigne Corpo Scientifico.

Anticipo frattanto le conclusioni, alle quali io giunsi colle mie investigazioni. Se queste furono cagione di un indebolimento della mia vista, che rimase intieramente spenta da arte matrigna per una soluzione concentratissima di *Atropa Belladonna*, possa almeno rimanere vivo e parlante un documento di quanto operai intorno allo spettro luminoso! L'indicazione delle pagine citate per cadauna conclusione si riferisce al mio manoscritto che sara' rassegnato, il quale e' di pagine 36. Seguano le mie conclusioni.

Dalla storia analitica degli spettri luminosi e dalle mie esperienze, che ho riferite, raccolgo aver determinato:

1°. Che lo spettro luminoso è un analizzatore chimico il piu' squisito che abbia la scienza fino al 1863, per iscoprire l'esistenza delle sostanze che ardono nelle fiamme e le loro variazioni (pag. 7, 12, 30, etc.)

2°. Che lo spettro luminoso è un fotoscopio che determina la quantitá e qualitá de' raggi luminosi, che vengono assorbiti dall' atmosfera, come lo comprovano gli spettri che ottenni a cielo sereno, vaporoso ed intieramente coperto con pioggia (pag. 15, 22, 25, 30).

3°. Che esistono righe fisse e righe mobili quali sono de 574 sottili di Fraunhofer frapposte alle principali, per cui non ho potuto mai avere in Venezia ed in Padova l'identico completo sistema di righe ottenute da Fraunhofer in Monaco (pag. 17).

4°. Che il foco chimico è distinto dal foco ottico, e l'uno e l'altro variabili nelle varie ore del giorno e dei mesi e nei varj stati dell' atmosfera (pag. 18–21).

5°. Che lo spettro ordinario e'circondato da due spettri secondarj policromici e da due spettri monocromici, che variano per forma e per dimensioni nelle varie stagioni dell' anno e nei differenti stati dell' atmosfera (pag. 18, 20, 22, 23).

6°. Che una camera oscura ad elementi fissi potrebbe farci scoprire nella successione degli anni quali siano le righe proprie ciascun astro e quali siano quelle che devonsi attribuire all' atmosfera terrestre (pag. 30).

7°. Che lo spettro luminoso potra' rivelarci i cambiamenti ai quali soggiaciono i sistemi planetarj e le loro atmosfere (pag. 30).

8°. Che il movimento e varia glossezza delle righe dimostrano i moti intestini de' gruppi molecolari e de' lori movimenti di traslazione; per cui lo spettro solare non solo è utile alla meteorologia, alla

fotografia, ma ancora alla conoscenza fisica de' sistemi stellari (pag. 30, 31).

9°. Che lo spettro di Newton è formato di due coppie di colori semplici cive' rosso e giallo, azzurro e violetto; gli altri tre aranciato, verde ed indaco, che sono gl' intermedj, sono composti di rosso e giallo, di giallo e azzurro, di azzurro e violetto, come emerge dalle mie sintesi ed analisi (pag. 16).

10°. Che oltre le linee fisse e mobili trasversali, esistono linee longitudinali, le quali pure variano in numero, grossezza e posizione nei varj stati dell' atmosfera e nei varj mesi dell' anno, e cangiando gli elementi dell' apparato, quali sono la grandezza dell' apertura del porta-luce, la distanza del prisma dal porta-luce, la distanza del piano di projezione dal prisma etc. (pag. 23, 24, 25, 27).

11°. Che nei fenomeni dello spettro luminoso interviene la natura del corpo raggiante, il mezzo attraverso il quale passano gli efflussi luminosi, e l'apparato stesso dell' esperienza (pag. 28, 29).

12°. Che i fenomeni dello spettro luminoso si derivano dal vario riflettersi, rifrangersi, disperdersi de' raggi luminosi (pag. 29).

Ho avuto la compiacenza che le mie esperienze furono coronate dalla scoperta di nuovi metalli e dai risultamenti ultimamente ottenuti in America e in Francia, come emerge da quelli di Rutherford, Porro, Babinet, Piazzi-Smyth, Mascart etc (Moniteur de la Photographie, pag. 141, 1er Decembre, 1863, No. 18, Paris; Comptes Rendus, tom, xxxv, pag. 413 e 479, an. 1852; Cosmos, vol. xxiii, pag. 604, an. 1863; Comptes Rendus, tom. lvii, pag. 789, an. 1863).

Non potesano essere piu' confortanti e piu' onorevoli per me le parole del Sigr. Dr. Phipson dotto inglese, il quale scrisse: "Les recherches ingenieuses de Mr. le Professeur Zantedeschi ont sans doute contribué beaucoup à amener cette belle partie de la science spectroscopique au point ou elle se trouve aujourd'hui." (Lettre de Mr. le Dr. Phipson à Mr. Ernest Lacour, sur l'histoire des decouvertes spectroscopiques; Moniteur de la Photographie, No. 18, 1er Décembre, 1861, pag. 143.)

Sono co' sensi di altissima stima e profondo rispetto.

PADOVA, il 6 di Gennajo, 1864.

Donations for the Library were received from the Bureau of Public Instruction and M. Delesse, at Paris; the Royal Astronomical, British Meteorological, Geological, and Royal Asiatic Societies; J. W. Dawson, of Montreal; the Essex In-

stitute; George Ticknor, of Boston; the New Bedford Library; Silliman's Journal; Blanchard & Lea and the House of Refuge, at Philadelphia; the Bureau of Agriculture and Smithsonian Institution, at Washington; and the Buffalo Society of Natural Sciences. On motion, the last-mentioned Society was ordered to be put upon the list of Corresponding Societies, to receive the Proceedings.

A copy of Proceedings, No. 70, just published, was laid upon the table.

A donation for the Cabinet was announced from Mr. Jos. H. Merriam, of Boston, consisting of eleven varieties of tokens and medals, and a collection of sixty-eight more, from Mr. Pliny E. Chase.

A photograph likeness of O. Böhtlingk was received for the Album.

The death of a member of the Society, Evan Pugh, President of the State Agricultural College near Bellefonte, was announced by Mr. Fraley.

The death of a member of the Society, General J. G. Totten, Chief of Topographical Engineers Department, U. S., at Washington, was announced by the Secretary. On motion of Mr. Fraley, Dr. Vethake was appointed to prepare an obituary notice of the deceased.

Mr. Chase presented for publication in the Transactions, a note to his own paper, on Linguistic Resemblances, by Mr. James E. Oliver, of Lynn, Mass., which, on motion, was referred to the same commmittee, Prof. Haldeman, Dr. Coates, Prof. Kendall.

The subject of reprinting the missing numbers of the first volume of Proceedings was then taken up, and on motion of Mr. Fraley, committed, with discretionary powers, to the Secretaries.

Pending nomination No. 522, and new nominations Nos. 523, 524, were read.

The Committee in relation to a site for a future Hall, reported, that in the present state of the currency, Mr. Harrison declined to name any price at which he will sell his lot on the south side of Penn Square, but has promised not to sell it to

any one without giving the Society the opportunity of purchasing. Signed, Eli K. Price, Chairman. On motion, the report was accepted and the committee continued, with orders to report again when needful.

The bill of Sherman & Son, for printing No. 70 of the Proceedings, &c., amounting to $187 75, was referred to the Treasurer.

And the Society was adjourned.

Stated Meeting, May 20, 1864.

Present, fourteen members.

Dr. Wood, President, in the Chair.

A letter accepting membership was received from James T. Hodge, dated Newburg, May 6th, 1864.

A letter accepting the appointment to prepare an obituary notice of General Totten was received from Prof. Vethake, dated Mantua, Philadelphia, May 19th, 1864.

Donations for the Library were received from the Essex Institute, Columbia College, Buffalo Young Men's Association, Franklin Institute, and Smithsonian Institution.

Dr. Le Conte offered for deposit in the Library a collection of Oriental works, selected from the library of his father, late Major Le Conte, which were accepted, and ordered to be suitably marked and kept together to be rendered on demand.

BOOKS DEPOSITED BY DR. LE CONTE. MAY 20, 1864.

Mosis Chorenensis Historiæ Armeniacæ, libri tres. Ed. Whistoni, filii. Lond. 1736. 4°.

Nineveh and Persepolis. W. S. W. Vaux. Lond. 1850. 8°.

Mellificium Historicum, complectens Historiam trium Monarchiarum; Chaldaicæ; Persicæ; Græcæ. Ch. Pezelio. Marpurgi, 1610. 4°.

Mohammedis filii Chavendschahi, vulgo Mirchondi, Historia Samanidarum Persice. Fr. Wilken. Gœttingæ, 1808. 4°.

Travels in Chaldea, in 1827. Cap. R. Mignan. Lond. 1829. 8°.

Berosi Sacerdotis Chaldaici. Ed. ult. Antverpiæ, 1552. 12°.

Jac. Perizonii Origines Babylonicæ et Egyptiacæ. Tomis II. C. A. Dukerus. Traj. ad Rhenum, 1736. 12°.

De Regio Persarum. B. Brissonii. Ex typ. Hier. Commelini, 1595. 12°.

A Geographical Memoir of the Persian Empire. J. M. Kinnear. Lond. 1813. 4°.

Elements of the Chaldee Language. W. Harris. New York, 1823. 8°. Pamp. 24 pp.

Narrative of a Journey to the Site of Babylon in 1811. Journey to Persepolis. C. J. Rich. Lond. 1839. 8°.

Dissertation on the Antiquities of Persepolis. W. Price. 4°. Pamp. 36 pp.

Observations on some Medals and Gems bearing Inscriptions in the Pahlavi Character. Sir W. Ouseley. Lond. 1801. 4°. Pamph. pp. 44.

Mémoire sur deux Inscriptions Cunéiformes Trouvées pres D'Hamadan. M. E. Burnouf. Paris, 1836. 4°. Pamph. pp. 193.

A Dissertation on the Newly Discovered Babylonian Inscriptions. Jos. Hager. Lond. 1801. 4°.

A Specimen of Persian Poetry; or, Odes of Hafiz. Translated by J. Richardson from Revizky's Specimen. Lond. 1802. 4°.

Travels in Georgia, Persia, Armenia, Ancient Babylonia, &c. Sir R. K. Porter. 2 vols. 4°. Lond. 1821.

Journeys through Persia, Armenia, and Asia Minor. J. Morier. Lond. 1812. 2 vols. 4°.

The History of Persia. Sir J. Malcolm. Lond. 1815. 2 vols. 4°.

Travels in Assyria, Media, and Persia. J. S. Buckingham. 2d Ed. 2 vols. Lond. 1830. 8°.

De Persidis Linguâ et Genio Commentationes. O. Frank. Norimb. 1809. 8°.

Tableau Général de l'Empire Othoman. M. De M. D'Ohsson. Paris, 1788. 7 vols. 8°.

The Persian Moonshee. Fr. Gladwin. Calcutta, 1801. 4°.

Journal of the British Embassy to Persia. W. Price. Lond. 1825. 2d Ed. Vol. I. Long quarto.

Tarich h. e. Series Regum Persicæ, ab Ardschir-Bakekan. W. Schikardo. Tubing. 1628. 4°.

Observations on the Ruins of Babylon, as described by C. J. Rich. Rev. T. Maurice. Lond. 1816. 8°.

Dissertations on the Rhetoric, Prosody and Rhyme of the Persians. F. R. Gladwin. Calcutta, 1801. 4°.

Tentamen Palæographiæ Assyrio-Persicæ. A. A. H. Lichtenstein. Helmst. 1803. 4°.

Historia Priorum Regum Persarum. M. Mirchond. Pers. et Lat. cum Notis. Viennæ, 1782. 4°.

Mémoires sur Diverses Antiquités de la Perse. A. J. Silvestre de Sacy. Paris, 1793. 4°.

Veteris Mediæ et Persiæ Monumenta. C. F. C. Hoeck. Gotting. 1818. 4°.

Arsacidarum Imperium sive Regum Parthorum Historia. J. Foy Vaillant. 2 vols. 4°. Paris, 1725.

Veterum Persarum et Parthorum et Medorum Religionis Historia. T. Hyde. Ed. secund. Oxon. 1760. 4°.

Travels in Various Countries of the East, more particularly Persia. Sir W. Ouseley. 3 vols. 4°. Lond. 1819.

The Oriental Collections of W. Ouseley. 2 vols. 4°. Lond. 1797, 1798.

Lexicon Persico-Latinum Etymologicum. J. A. Vullers. Vol. I. 1855, bound, and unbound fasciculi, V i, V ii, VI i, VI ii (the rest wanting). Bonn, 1856.

De Fatis Linguarum Orientalium Arabicæ nimirum Persicæ et Turcicæ Commentatio. Viennæ, 1780. F.

A Dictionary, Persian, Arabic and English, with a Dissertation, &c. J. Richardson. New Edit. By C. Wilkins. Lond. 1806. 2 vols. 4°.

Sabæan Researches. J. Landseer. Lond. 1823. 4°.

Sententiæ Ali Ebn Abi Talebi Arabice et Latine. C. Van Wænen. Oxon. 1806. 4°.

An Arabic Vocabulary and Index for Richardson's Arabic Grammar. T. Noble. Edin. 1820. 4°.

A Hebrew and English Lexicon. W. Gesenius. Trans. by E. Robinson. 4th Ed. Boston, 1850. 8°.

An Historical and Critical Inquiry into the Interpretation of the Hebrew Scriptures. J. W. Whittaker. Cambr. 1819. 8°.

Lexicon Hebraicum et Chaldaicum J. Buxtorfii. Ed. nov. Glasguæ, 1824. 8°.

Institutiones Linguæ Hebraicæ R. Bellarmini. Paris, 1622. 12°.

Dissertationes Miscellaneæ H. Relandi. Traj. ad Rhen. 1706. 12°.

The Israelitish Authorship of the Sinaitic Inscriptions. C. Forster. Lond. 1856. 8°.

A Hebrew Primer. Bishop of St. David's. Pamph. 16 pp. 16°.

Dissertationes Selectæ, varia S. Litterarum et Antiquitatis Orientalis Capita D. Millii. Lugd. Bat. 1743. 4°.

Biblia Hebraica B. A. Montani. (Hebrew text, with interlinear Latin translation and side notes.) 1581. F.

Genesis in Hebrew, with New Translation. De Sola, Lindenthal, and Raphall. Lond. 5604—1844. 8°.

Analysis and Critical Interpretation of the Hebrew Text of Genesis, preceded by a Hebrew Grammar. W. Paul. Edin. and Lond. 1852. 8°.

Introduction to Genesis, with a Commentary on the opening portion. From the German of P. Von Bohlen. J. Heywood. 2 vols. Lond. 1855. 8°.

Questiones Mosaicæ; or, the Book of Genesis compared with the Remains of Ancient Religions. O. de B. Priaulx. London, 1842. 8°.

Genesis Elucidated. J. J. W. Jervis. Lond. 1852. 8°.

Genesis and Exodus. Being the first two volumes of A Historical and Critical Commentary on the Old Testament. By M. M. Kalisch. Lond. 1858 and 1855.

Jewish School and Family Bible, in 3 vols. 8°. A. Benisch. Lond. 1851.

Ascensio Isaiæ Vatis. R. Lawrence. Oxon. 1819. 8°.

Primi Ezræ Libri, Versio Ethiopica. R. Laurence. Oxon. 1820. 8°.

The Times of Daniel. George, Duke of Manchester. Lond. 1845. 8°.

Woodruff on Daniel's 70 Weeks. 4°.

An Explanation of the 70 Weeks. J. Caverhill. Lond. 1777. 8°.

A Chronological Essay on the Ninth Chapter of Daniel. P. Lancaster. Lond. 1722. 4°.

Chronology of the Times of Daniel, Ezra, and Nehemiah. J. W. Bosanquet. Lond. 1848. 8°.

In Librum Danielis R. Rolloci Scoti. Ed. alt. Genevæ, 1610. 16°.

Josippon, sive J. Ben-Gorionis Historiæ Judaicæ Libri Sex. Ex. Heb. Lat. J. Gagnier. Oxon. 1706. 4°.

Historia Imp. Vet. Joctanidarum in Arabia Felice ex Abulfeda. Persian Text. 4°.

Specimen Historiæ Arabum, sive Gregorii Abul Farajii Malatiensis de Origine et Moribus Arabum E. Pocockii. Oxon. 1650. 4°.

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Dr. Wilcocks presented for publication in the Transactions, a memoir entitled: "Thoughts on the Influence of Ether in the Solar System; its relations to the Zodiacal Light, Comets, the Seasons, and Periodical Shooting Stars;" which, on motion, was referred to a Committee consisting of Prof. Kendall, Prof. McClune, and Mr. Marsh.

Dr. Wilcocks read the following synopsis of the communication:

The paper describes briefly the ideas entertained of Ether by the Hindoos, as well as by two of the schools of Greece; but asserts that it is not by the aid of any such fluid that I shall undertake to explain the cause of the phenomena mentioned in the title. My only purpose in dwelling upon the ancient theories is, to show how they have biased the minds of modern astronomers.

The discovery of Professor Encke, I have offered as the first rational evidence of the existence of a resisting medium in space, and have made a suggestion regarding the density of the Ether in different parts of the solar system.

The fact of our intercourse with matter being altogether with gross substances, I have urged as the great difficulty of appreciating the nature of ether; and have proposed that while discussing the

subject, we should endeavor to lay aside notions of matter already acquired, and try to view it as we believe it to exist in the celestial spaces.

The physical constitution of the sun, as received by the best authorities, I have described as far as I believe it to influence the motion of the ether. The rotation of that orb upon its axis, with the position of the latter with reference to the ecliptic, I have recounted; also the observations of Secchi upon the relative heat of different parts of the sun's surface, and the influence of this difference of heat in determining the character of the ethereal currents.

After duly considering the effect of these agencies upon each other, the conclusions are reached that the ether in the solar system is in constant motion, that it performs a circulation from the sun's poles to the equator, and thence into the region of the planets, and finally returning to the sun's poles, descends thereon in the form of vortices; that the shape of the mass, as it advances into space, is that of a huge plate, or more precisely a hollow cone, whose apex forms a highly obtuse angle at the sun's centre.

The existence of reflecting matter in the ether is shown from the corona of light seen round the moon during a total eclipse of the sun.

It is suggested that a perspective view of the ascending current of ether, as it advances through the region of the planets, produces the appearance known as the zodiacal light.

The weak points of former explanations of this phenomenon are exposed, and the claim urged that the theory of ethereal currents, derived altogether from independent data, affords the best explanation.

All the positive information we have upon the subject of ether is derived from its effect upon comets, but long before Encke's day, Sir Isaac Newton had undertaken to explain some of the most prominent features of these bodies, upon the hypothesis of their moving through a material fluid.

The views of Newton, with respect to the position of the tails of comets, I have noticed, with the reflection, that neither in his own day nor ours have his ideas upon the subject received that support from astronomers to which their merit entitles them. I have suggested several reasons to account for the fact.

The ingenious and plausible hypothesis of M. Valz respecting the density of the ether in the solar system, is described, with his expla-

nation of the reduction of volume in comets on approaching the sun, and their subsequent increase on receding from that luminary.

The non-concurrence of M. Arago and Sir John Herschel in the theory of M. Valz is given as evidence of the influence of the ancient theories of ether at the present time upon the minds of astronomers.

The existence of the ascending current of ether near the ecliptic is offered in explanation of certain peculiarities of Halley's comet, which have been observed in five of the eight visits which that body has made to its perihelion since the year 1305.

The vortical currents which descend upon the poles of the sun, are urged as the causes of the exceptional position of the tails of such comets as have passed through them.

The catalogues of comets in the works of M. Arago and Mr. Hind show that the orbits of all those bodies which have had tails directed towards the sun, have had an inclination of more than seventy degrees, and a perihelion distance less than one-fourth the radius of the earth's orbit.

The ascending current of ether which, owing to the reflecting matter which it contains, becomes visible to us as the zodiacal light, cannot be of as low a temperature as the surrounding medium.

In order to show the influence of ether upon the seasons, I have traced, by the aid of *à priori* reasoning, the path of the ascending current through the solar system.

I have determined by calculation the points where the earth passes through the current, and endeavored to demonstrate that the first passage occurs in the month of August, and produces the canicular days; the second passage takes place in November, and is the cause of the season known as the Indian summer.

Several minor influences of the ethereal currents upon the seasons are suggested, and the effort made to connect, through the relation of cause and effect, these influences with known phenomena.

A belief in the ethereal origin of the dog-days and the Indian summer, naturally leads to the inquiry, May not the numerous sporadic shooting stars seen about the 10th of August, and the showers of them sometimes seen on the 12th of November, proceed from the same cause? Under the impression that this might be the case, I was induced to search for the existence of some numerical coincidence between the grand November exhibitions of shooting stars, and the sidereal year.

I found that the number of days between the years of the great

exhibitions, 1799 and 1833, was 12418.704, and that the number of days in 487 rotations of the sun are 12418.5, the difference being only four hours and forty-eight minutes.

It is, therefore, proved that any part of the sun's surface turned towards the earth, at any given point in its orbit, in the year 1799, was also turned towards the earth at the same point of its orbit, in 1833, and will be again in 1867 and 1901.

Messrs. Bunsen and Kirchoff have ascertained that the sun's atmosphere contains metals in the vaporous state.

If we permit ourselves to believe that a portion of this metallic vapor escapes from the sun's atmosphere without undergoing the chemical change which produces the light and heat, and if this metallic vapor be transported to the earth's orbit by the ethereal current, it will be liable to an encounter with our planet in those parts of its yearly path, where it passes through the ascending current of ether, viz., in August and November.

If, in addition to this, we believe that a certain part of the sun's surface either constantly or frequently emits this metallic stream, the periodical recurrence of the meteoric shower may be looked for at intervals of thirty-four years.

I have illustrated my theory with several diagrams, which are based upon the observations of astronomers of established reputation. One of these diagrams shows the relation between the sun's equator, the ecliptic, and the ascending current of ether. The distance of the earth from the last at different seasons of the year, is made apparent. On comparing it with the table of MM. Coulvier, Gravier, and Saigey, a curious agreement is shown to exist between the distance of the earth at different seasons from the ascending current of ether, and the occurrence of shooting stars.

I have resigned the subject with the conviction that as it is one of immense interest, and has received no justice at my hands, it will speedily excite the attention of those who have made special studies of the various phenomena which I have endeavored to combine under one cause.

The Committee on Mr. Oliver's note to Mr. Chase's memoir, to be published in the Transactions, reported in favor of its being published with the memoir; which, on acceptance of the report, was so ordered.

Mr. Foulke presented for the Library a copy of the libretto of Mr. Fry's new opera of Notre Dame of Paris, and spoke

of the adaptability of sounds, especially the vowel sounds of the English language, to musical compositions of this order.

Mr. Foulke exhibited, also, a curious specimen of a triple orange.

Prof. Lesley made a communication on the Abbeville quarries, which led to a discussion on the subject of the sufficiency of the evidence, as yet obtained, for the alleged super-antiquity of the human remains found in the diluvium; Dr. Goodwin especially objecting the high authority of M. Elie de Beaumont, and the doubts resting upon the precise relationship of the Loess.

The interesting discussions of the last three years over the views of our fellow-member, M. Boucher de Perthes, and especially the fresh discussions to which the alleged discovery of a human jaw near Abbeville had given an impetus, induced me to visit his famous collection and the quarries from which his earlier specimens had been obtained. In London, I had learned that the English geologists had accepted the genuineness and diluvial antiquity of the implements, but rejected that of the jaw. In Paris, I found, on the contrary, that the geologists, with the exception perhaps of M. Elie de Beaumont, and also the ethnologists, had agreed to place the jaw in the same category with the implements. Dr. Broca, the Secretary of the Anthropological Society, had the goodness to show me the manuscript report of the joint commission of English and French savants, since published by the Academy, authoritatively declaring its genuineness. On my return to England, Mr. Evans assured me that the jaw was a forgery, and that he had proven the forgery of many of the implements also.

The change of view manifested by Sir Charles Lyell in his recent work on the Antiquity of Man, in relation to the genuineness and antiquity of the Natchez *pelvis*, had been commented on with much interest and some surprise, as opposed to the current of English sentiment respecting the whole subject. Sir Charles, when in America, had convinced himself that Dr. Dickeson's *pelvis* was a mistake, it being merely the *os innominatum* of some Indian girl, fallen from an ancient graveyard at the surface above, among the debris of the cliff formation which held the extinct remains of the post-pleiocene period. Those of us who were present at the meeting of the Academy of Natural Sciences in Philadelphia, at which Dr. Dickeson presented the bone to the Cabinet, will remember the indif-

ference with which it was presented, and the silence with which it was received. The fact is, no one was prepared, twenty years ago, for such a fact It was as blinding and unpleasant as a flash of sunlight in a mirror. The intellectual eyes of science must become accustomed to such astounding discoveries. It required thirty years to produce a state of science in Europe susceptible to the impression which M. Boucher de Perthes' cabinet had a destiny to make. And nearly as long a time was required to obtain for the Natchez pelvis the first reception into the text-book of a distinguished geologist. At the instigation of Dr. Falconer, I am happy to say that Dr. Leidy has promised to renew the discussion of this bone by instituting a chemical and microscopic examination of its condition. We may then know more about its antiquity. But since the discovery by M. Desnoyers of pleiocene fossil bones, scratched and cloven by the hands of men, there is no longer any good reason for throwing doubt upon its alleged geological position.

The distinguished chief of geology in France, M. Elie de Beaumont, is understood to occupy solitary ground in the matter of the Abbeville implements. Their antiquity depends upon that of the formation in which they lie, and upon the fact that they lie in it mixed with the bones of extinct species of animals. If the formation be strictly *in situ*, there is no escape from the conclusion that the implements and the bones are of equal age, and therefore that Man lived with these extinct animals. If, on the contrary, it can be shown that the formation is an after-make, a slide from above, a debâcle, a local deposit hastily brought together from different neighborhoods, the argument for the antiquity of the implements is lost. Elie de Beaumont is said to assume Cuvier's view of the formation, and calls it a slide from the upland into the valley of the Somme, and then denies the antiquity of the implements.

It was especially with a view to form an opinion upon this point that I visited Abbeville; and after enjoying the same courteous reception from M. Boucher de Perthes that he accords to all strangers, I examined the quarries in the neighborhood; first, that of Moulin Quignon, where the jaw was said to have been found; and then those of Menchecourt. The former had so fallen in that I could not obtain access to the depth at which the jaw is placed. But I saw no reason to imagine any change in the original condition of the deposit. There is no escarpment or steep valley wall to give the remotest chance of a slip. The whole valley is shallow, and the slopes are so gentle that it is hard to say where the valley ends and

the table-land begins. Whatever the age of the gravel and loam, they undoubtedly rest upon the old topography of the chalk just as they were at first deposited upon it.

Returning through the old city and going out over its moats in the opposite direction, I was driven through the long one streeted-village of Menchecourt. Behind the houses, at the distance of a hundred yards, are the quarries, with their common floor on a level with the site of the village and their vertical faces, or stopes, rising behind to the height of from twenty to thirty feet, no more. As they are slowly cut back into the upland, the stoping becomes higher; but so gentle is the slope of the land, in that direction, that years will be consumed in obtaining a face of twice that height. There is not the least appearance of a slide anywhere. The soil above, the layers of broken flint and loam, are evidently in their normal condition. The original stratification is nowhere concealed or confused by subsequent movements from above. The "falsebedding" or oblique deposition is curiously visible, and affords abundant evidence of the diversity of currents which introduced the materials. In a few places the subordinate members of the section express themselves by waved lines, suggesting lateral pressure, but not in the form so well known to geologists, where the mass is broken and crumpled by a side thrust or by a slip of the upper upon the under strata. The characteristic feature of all quiet, loamy, and sandy deposits, viz., the isolation of lenticular belts of one stratum inside of the limits of the stratum next above or below, is beautifully exhibited. The distribution of the chalk fragments is also open to easy study. But the most striking appearance is that presented by perfectly horizontal parting planes, marked sometimes by thin beds of equally distributed broken flints. Such are, for example, the two lines between b and c, and ç and d, in Fig. 1, Plate VII.

In this section, *a* represents a layer of broken flints, no doubt a river shore. It passes down into a fine loamy sand. Beneath the second thin horizontal sheet of broken flint, the mass of loam *d* is stratified in lenses, alternately greenish and yellowish. No chalk or gravel is seen at the floor of the quarry here.

Fig. 2, is a section about 100 paces west of Fig. 1, *a*, 1½ metres thick, is a stiff clay, with a few broken flints at the top and at the bottom; *d*, a reddish, yellowish clay, tolerably well filled with broken flints; *b*, 1 metre, is quite filled with broken pieces of chalk and broken flints; *c*, is a perfectly homogeneous mass of drab or dove-colored loam, 2 metres of which are visible, and no floor.

Fig. 3 lies still further west, along the face of the back wall of the quarry, and shows the streams or streaks of broken flints appearing and disappearing in the body of the mass of yellowish loam; *a*, is the upper covering of humus. The section is on the same scale with that of Figs. 1 and 2. But the scale of Fig. 4 is enlarged to show the engagement of white loam (*d*), in waved lenses, parallel to each other, in the body of the homogeneous mass of darker, slightly reddish loam (*c*); and *vice versa* the appearance of waved lines and lenses of *c* in the lower part of *b*; *a* is an overlying stratum of coarse loam, charged with flint, and resting on a layer of broken flints; *b* is a homogeneous mass of yellow loam.

It is apparent from these sections that the formation is in its pristine condition. The floor of chalk appears suddenly and at an unexpected height, within two or three paces of Fig. 4, forming as it were, a little cliff in the deposit, but no special collection of broken flints lies in immediate contact with it, and but a very few fragments of chalk, and those of a very small size. There is no appearance of tumultuous deposition in the faces of these quarries. The shore must have had a gentle slope, and no wide sheet of water before it; otherwise, the powerful waves of a great lake or ocean frith, would have left their common marks. The width of the valley of the Somme, as it now exists, could not have been greatly exceeded; and if we suppose a river current, we can understand why the flint implements should fall from canoes or floats, or favorite fishing stations, and lie where they fell, while the naked corpse of any unfortunate savage drowned at his trade would be floated out to sea.

There is no reason to suppose any great physical break in the history of man upon the earth. Granted that the English Channel has been eroded; the action was perhaps characterized by a deliberate regularity. Granted that the change which determined the incipient necessity for its erosion, was some great change of sea level in Northwestern Europe; it does not follow that the change, however great, was not equally gradual. We may regard the banks of the Somme as haunted by men from the beginning of human life in Europe; whether they were washed by a small river, or by the narrow arm of the sea. No doubt there have been epochs of entire submergence, during which all Northern France was once more made a shallow sea, like the North Sea now. But the race of men and the races of beasts may have retired so slowly before the scarcely noticeable advance of the sea level edge, and so slowly pursued it on its retreat again, as not to have been aware of any change in what to them was

a fixed and unalterable state of things in the relation of land to sea. Thus similar changes go on now; why should we imagine it otherwise in ancient times? Until we can prove it to have been otherwise, we have no right to apply with rigor the epithet antediluvian to these remains of man.

I may add, that on my way to Neuchâtel to visit my friend Prof. Desor, and while I was being entertained in the most delightful manner by M. Troyon, with an inspection of the many rare piloti relics in his museum at Lausanne, I learned that Desor was in Africa with two other members of a commission of the French Government, studying the age of the Sahara. Sketches of their results have been published by him since their return, by which we learn that they have fully confirmed the opinions of previous explorers, that the north of Africa has risen very recently from beneath sea level, probably in the human age. Or, perhaps we should say, as Herr Trautschold would have it (Zeitsch. der Geol. Gesell. 1863, p. 411), the ocean bed has deepened itself since man was created, so as to drain the whole Sahara and Libyan desert land. The commission found the *Cardium edule* not only embedded within the rock of the desert, but at a fixed horizon over some hundred miles of their route, and this shell fish was the chief food of the savages of the stone age.

The obliteration of so much sea surface, whether rapidly or slowly effected, must have produced one of the greatest alterations in the physical condition of the surface of the earth, on that side of it. While the Mediterranean waters covered Northern Africa (with the exception of the Atlas Mountains, the Abyssinian highlands, and other unknown mountain ranges under or beyond the equator), more humid winds must have fertilized Arabia, Persia, and Bokhara, and ameliorated the rigors of Thibet and China, if it could not quite prevent the formation of the Desert of Tobi. On the other hand, rains must have swollen the Caspian and Aral seas to such a height, that they then made but one, overflowing the lower steppes and confounding themselves with the Azof and Black Sea shores, and with the Northern Ocean.

If, then, mankind appeared on earth previous to the drying up of the Sahara, he had three widely separated continents to appear upon: Southern Africa, Eastern and Southern Asia, and Western Europe. If the change from that condition of things to a condition of things analogous to that we see now, was accomplished with sufficient rapidity to permit of the formation of a tradition, such tradition could hardly assume any other shape than that of the Noachian deluge.

Ignorant of the cause, the manner, and the extent of the change, the imagination of savages would recast the facts in the mould of their daily experience.

We can understand, also, on this hypothesis, why the Arkism of mythology finds its classic land in Africa, and becomes Helio-arkism only in Asia. A subject which I should be glad to find the time to discuss at length before the Society.

Neither the growth-rings of the trees on the Ohio valley mounds, nor the cypress layers in the Delta of the Mississippi, nor the coral reef series of Florida, nor the thickness of the Somme Valley peat, nor that of the stalagmite cover of the fossil clay of the caves, nor the borings made in the Memphis sands at the foot of the monuments, have afforded us even an approximate scale of years wherewith to measure man's residence on earth. The Cone of the Tinnière, near Villeneuve, has yielded to Prof. Morlot the first precise statement of human time made by human fossils. As he reads it, the bronze age dates back from our time from 2900 to 4200 years, and the stone age from 4700 to 7000 years. (Etudes Géol. Archiv. Bull. Soc. Vaud. vi, p. 325.) M. Gillieron makes the age of his lake habitation relics at least 6750 years. (Actes de la Soc. Jurass. d'Emulation, 1860.) But these are both merely common historic dates.

If, however, I have not misunderstood a communication made to me by our fellow-member, Dr. A. A. Henderson, of the U. S. Navy, there exists a singularly perfect scale of years for archæologists, under the tropics, wherever the wet and dry seasons are semi-annual and regular. Near Rio Janeiro are certain caves in limestone, containing the usual accumulations of stalactitic and stalagmitic matter, the latter covering a bone clay, in which the implements of man have been found, chiefly arrowheads. Dr. Ildefonso, the well-known botanist and naturalist of Rio Janeiro, informed Dr. Foltz that he had made himself well acquainted with the caves of the Provinces of Minas Duras, and Santos, and their contents, and that his daughter had repeatedly counted the delicate layers of the lime deposit over the bone clay, produced by the seasons of rain and percolation, interrupted by dry seasons of dusty weather, during which, there being no percolation from the surface through into the caves, there consequently was no deposit of alabaster, but in lieu of it a deposit of dust; and he declared that the number of the layers amounted to twenty thousand (20,000). Should this curious observation be repeated and accepted, the question of the great antiquity

of man will be set at rest; and both those who believe in the original unity, and those who believe in the original diversity of races, will have that free scope given to their theoretic methods which a practically unlimited amount of time at their command is calculated to afford. Dr. Ildefonso is understood to assert that the annual character of the laminæ has been confirmed.

Pending nominations Nos. 522, 523, 524, were read, and the Society was adjourned.

Stated Meeting, June 17, 1864.

Present, six members.

Prof. TREGO, Secretary, in the Chair.

Letters accepting membership were received from G. Kirchhoff, dated Heidelberg, June 2d, and from Otto Heer, dated Zurich, April 10th, 1864.

Letters acknowledging the receipt of publications were received from the Boston Athenæum, May 31st; Boston Library, June 7th; Connecticut Historical Society, May 23d; New York State Library, May 21st; New York Historical Society, May 19th; Washington Observatory, May 18th, and Chicago Historical Society, May 19th, 1864.

Donations for the Library were received from the Government of the Netherlands, Bureau des Mines, Royal Astronomical Society, Essex Institute, Harvard and Yale Colleges, Prof. Tyler, of Amherst, American Oriental Society, New York Lyceum, New York Historical Society, Academy of Natural Sciences, Franklin Institute, and Brigadier-General Dr. Hammond.

Photographic likenesses of S. F. B. Morse, Lewis Agassiz, Oswald Heer, Spencer F. Baird, E. W. Brayley, and J. F. W. Herschel, were received for the album.

The committee to which was referred the paper of Dr. Wilcocks at the last meeting, reported in favor of its publication in the Transactions. On motion, the report was accepted and agreed to.

Mr. Chase made the following communication:

The remarkable coincidence which I have pointed out, between the theoretical effects of rotation and the results of barometrical observations, has led me to extend my researches with a view of defining more precisely some of the most important effects of lunar action on the atmosphere. The popular belief in the influence of the moon on the weather, which antedates all historical records, has received at various times a certain degree of philosophical sanction. Herschel and others have attempted partially to formulate that influence by empirical laws; but the actual character of the lunar wave that is daily rolled over our heads appears never to have been investigated. Major-General Sabine showed that the moon produces a diurnal variation of the barometer, amounting to about .006 of an inch, which is equivalent to nearly one-tenth of the average daily variation near the equator. This would indicate a tidal wave of rather more than one foot for each mile's depth of atmosphere, or from three to six feet near the summits of the principal mountain chains. It is easy to believe that the rolling of such a wave over the broken surface of the earth may exert a very important influence on the atmospheric and magnetic currents, the deposition of moisture, and other meteorological phenomena. As the height of the wave varies with the changing phases of the moon,* its effects must likewise vary, in accordance with mathematical laws, the proper study of which must evidently form an important branch of meteorological science.†

Besides this daily wave, there appears to be a much larger, but hitherto undetected, weekly wave. M. Flaugergues,‡ an astronomer at Viviers in France, extended his researches through a whole lunar cycle, from Oct. 19, 1808, to Oct. 18, 1827, and he inferred, from his observations:

1. That, in a synodical revolution of the moon, the barometer rises regularly from the second octant, when it is the lowest, to the second quadrature, when it is the highest; and then descends to the second octant.

2. That the varying declination of the moon modifies her influ-

* The height at St. Helena appears to fluctuate between about .9 and 1.6 feet.

† For some interesting experimental evidences of the effect of the moon's changes on the fall of rain, see the published observations of Messrs. F. Marcet (Silliman's Journal, 27, 192), and J. H. Alexander (Silliman's Journal, N. S., 12, 1).

‡ Bib. Univ., Dec. 1827, and Silliman's Journal, 15, 174.

ence, the barometer being higher in the northern lunistice than in the southern.

3. That the action of the moon also varies with its distance from the earth, the mean barometric height being less in perigee than in apogee.

The observations indicate the following average meridional fluctuations of the barometer:

1. In a semi-synodical revolution, 1.67 mm., or .065 in.
2. Between the lunistices, 29 mm., or .011 in.
3. Between perigee and apogee, 1.12 mm., or .044 in.

The more recent and more complete observations at St. Helena give somewhat different results, which serve to confirm the natural *à priori* conviction that there must be two maxima and minima in each month. The means of three years' hourly observations indicate the existence of waves, which produce in the first quarter a barometric effect of + .004 in.; in the second quarter of — .016 in.; in the third quarter of + .018 in.; and in the fourth quarter of — .006 in.; results which appear to be *precisely* accordant, in their general features, with those which would be naturally anticipated from the combination of the cumulative effect of the moon's attraction with the daily wave of rotation, and the resistance of the æther.

One peculiarity of this lunar-aerial wave deserves notice for the indirect confirmation that it lends to the rotation theory of the daily aerobaric tides, and the evidence it furnishes of opposite tidal effects, which require consideration in all investigations of this character. When the daily lunar tides are highest their pressure is greatest, the lunar influence accumulating the air directly under the meridian, so as to more than compensate for the diminished weight consequent upon its "lift." But in the general aerial fluctuations, as we have seen, and also in the weekly tides, a high wave is shown by a low barometer, and *vice versâ*. The daily blending of heavy and light waves produces oscillations, which are indicated by the alternate rise and fall of the barometer and thermometer at intervals of two or three days.

M. Flaugergues' observations at perigee and apogee seem to show that a portion of the movement of the air by the moon is a true lift, which, like the lift of rotation, must probably exert an influence on the thermometer as well as on the barometer. On comparing the daily averages at each of the quadratures and syzygies, I found the difference of temperature too slight to warrant any satisfactory inference; but a similar comparison of the hourly averages, at hours

when the sun is below the horizon, gave such results as I anticipated, as will be seen by a reference to the following

TABLE OF BAROMETRIC AND THERMOMETRIC MEANS AT THE MOON'S CHANGES.

Moon's Phase.	Average height of Barometer in inches.	Height of Weekly Tides.	Height of Daily Tides.	Height of Thermom. Daily Average.	Thermom. at 12 P.M.	Thermom. at 4 A.M.
Full, . .	28.270	—.0115 in.	.0054 in.	61.67°	60.22°	59.787°
Third Qr. .	28.289	+.0065 "	.0087 "	61.68	60.41	59.824
New, . .	28.282	+.0005 "	.0064 "	61.65	60.31	59.716
First Qr. .	28.286	+.0044 "	.0047 "	61.63	60.37	59.823

In obtaining the above averages I was obliged to interpolate for such changes as took place on Sundays or holidays, when no observations were taken. The interpolation, however, does not affect the general result; and, on some accounts, the table is more satisfactory than if the observations had been made with special reference to a determination of the lunar influences, accompanied as such a reference would very likely have been by a bias to some particular theory.

The thermometric and barometric averages show a general correspondence in the times of the monthly maxima and minima,—the correspondence being most marked and uniform at midnight, when the air is most removed from the direct heat of the sun, and we might therefore reasonably expect to find the clearest evidences of the relation of temperature to lunar attraction.

By taking the difference between the successive weekly tides, we readily obtain the amount of barometric effect in each quarter. The average effect is more than three times as great in the second and third quarters, as in the remaining half month,—a fact which suggests interesting inquiries as to the amount of influence attributable to varying centrifugal force, solar conjunction, or opposition, temperature, &c.

Although, as in the ocean tides, there are two simultaneous corresponding waves on opposite sides of the earth, these waves are not of equal magnitude, the barometer being uniformly higher when the moon is on the inferior meridian, and its attraction is therefore exerted in the same direction as the earth's, than when it is on the superior meridian, and the two attractions are opposed to each other.

I find, therefore, marked evidences of the same lunar action on

the atmosphere as on the ocean,—the combination of its attraction with that of the sun producing both in the air and water, spring tides at the syzygies, and neap tides at the quadratures; and I believe that the most important normal atmospheric changes may be explained by the following theory:

The attraction and rotation-waves, as will be readily seen, have generally opposite values, the luni-solar wave being

Descending, from 0° to 90°,* and from 180° to 270°.

Ascending, from 90° to 180°, and 270° to 360°.

While the rotation-wave is

Ascending, from 330° to 60°, and 150° to 240°.

Descending, from 60° to 150°, and 240° to 330°.

From 60° to 90°, and 240° to 270°, both waves are descending, while from 150° to 180°, and 330° to 360°, both are ascending. In consequence of this change of values, besides the principal lunar maxima and minima at the syzygies and quadratures, there should be secondary maxima and minima at 60° in advance of those points.

The confirmation of these theoretical inferences by the St. Helena observations appears to me to be quite as remarkable as that of my primary hypothesis. If we arrange those observations in accordance with the moon's position, and take the average daily height of the barometer, we obtain the following

TABLE OF THE LUNAR BAROMETRIC TIDES.

MOON'S POSITION. θ	MEAN DAILY HEIGHT OF BAROMETER AT ST. HELENA. 28 inches + the numbers in the Table.			
	1844.	1845.	1846.	Average. 1844–6.
0°	.2621	.3020	.2701	.2781
15	.2650	.3058	.2693	.2800
30	.2707	.3153	.2707	.2856
45	.2691	.3165	.2688	.2848
60	.2625	.3077	.2688	.2797
75	.2682	.3093	.2783	.2853
90	.2667	.3184	.2800	.2884
105	.2593	.3170	.2721	.2828
120	.2595	.3124	.2686	.2802
135	.2677	.3099	.2691	.2822
150	.2712	.3118	.2715	.2848
165	.2710	.3104	.2735	2850
180	.2621†	.3020	.2701	.2781

* Counting from either syzygy.

† Since the tabular numbers represent the *semi-axes* of the barometric curve, and not the simple *ordinates*, the values for 0° and 180° are the same.

This table shows—

1. That the average of the three years corresponds *precisely* with the theory, except in the secondary maximum, which was one day late.

2. That the primary maximum occurred at the quadratures in 1845 and 1846, and one day before the quadratures in 1844.

3. That the primary minimum occurred at the syzygies in 1844 and 1845, and one day after the syzygies in 1846.

4. That 1846 was a disturbed year; and, if it were omitted from the table, each of the remaining years, as well as the average, would exhibit an entire correspondence with theory, except in the primary maximum of 1844.

5. That 1845 was a normal year, the primary and secondary maxima and minima all corresponding with theory, both in position and relative value.

6. That the deviations from perfect correspondence with theory can be easily explained by the relative positions of the two aerial ellipsoids of rotation and attraction.

7. That the tertiary maxima and minima, or the turning-points between the primary and secondary maxima and minima, are less stable than the primaries and secondaries.

At extra-tropical stations I should look for important modifications of the theoretical results, some of which I propose to explain in a future communication.

Mr. Lesley drew the attention of the members to the researches of M. Delesse on the quantity of "water of imbibition" and "water of the quarry" contained in rocks, published in the Bulletin of the Geological Society of France (2e ser. t. xix, p. 64, séance du 4 Nov., 1861), as having an important bearing on the ancient changes of sea-level.

The tables of M. Delesse, given on pp. 66, 69, 72, go to show that dry specimens of gypsum, limestone, chalk, slate, sandstone, gneiss, granite, &c., can be made to imbibe an amount of water equal to from 1 per cent. to 40 per cent. of their weight; and that in their natural places they hold from 1 per cent. to 30 per cent. of water permanently; granite holding 15 per cent.; argillaceous rocks 20 per cent. or more; and the magnesian rocks a still larger percentage. The whole exterior of the crust of the earth is bathed in

surface water, which penetrates all its formations, and descends step by step to a depth, which is probably limited by the horizon of radiant heat equal to 100° C., that is, to a depth of at least two miles. At various stages the descending percolation, aided by a universal fissure and crevasse system, forms water horizons and reservoirs, subject to enormous hydraulic pressure, reproducing the water at the surface, either through natural springs or artificial wells. It is not too much to say, then, that 20 per cent. of the crust of the earth, to a depth of two miles, consists of disseminated and collected water. This will take into account condensation descending.

What, then, was the case in early days when the horizon of 100° C. was at the surface? We must conclude that all this water was at that time excluded from the crust, and compelled to remain above the surface as heated ascending aqueous vapor, and descending rain; and, of course, keeping the general sea-level higher than at present.

Taking the mean density of all rocks near the surface at 3.00, the 20 per cent. of water contained in a stratum of crust two miles deep, will represent more than six hundred feet of water in mass; and, taking one-third of the earth's surface as land, and confining the desiccation to the land surface alone, we have an elevation of the general level of the other two-thirds, or ocean-surface of the planet, equal to four hundred feet; enough to submerge a considerable percentage of the area of each one of the existing continents.

Pending nominations Nos. 522, 523, 524, and new nomination No. 525, were read.

On motion of the Librarian, seconded by Dr. Coates, it was ordered, that copies of Part I of the Catalogue be sent with Part I, Volume XIII, of the Transactions, in the next distribution, to Corresponding Societies which receive the Transactions.

And the Society was adjourned.

COMMUNICATION ON AN ANTIQUE STONE HAND-HAMMER. BY F. PEALE.*

In a late work, entitled "Geological Evidences of the Antiquity of Man," by Mr. Lyell, page 184, there is a description, illustrated by a wood-cut, of a cave situated on the side of a hill near Aurignac, department of the Haute Garonne, France; with a description of the bones of various animals found therein, associated with the works of man, as well as remains of his osseous structure.

Among the articles was one thus described by him: "Outside the entrance was found a stone of a circular form, flattened on two sides, with a central depression, composed of a tough rock, which does not belong to that region of the Pyrenees. This instrument is supposed by the Danish antiquarians to have been used for removing by skilful blows the edges of flint knives, the fingers and thumb being placed in the opposite depressions during the operation."

A similar instrument was lately added by myself to the cabinet of the Society as a "*hand-hammer*" (a drawing of which accompanies this communication). See Plate vii, Fig. 1.

This instrument is submitted to the personal inspection of the members. It will be observed that its entire correspondence with the description by Mr. Lyell of the specimen found near the cave at Aurignac, France, is so perfect, that it might, without explanation or exception, have been applied to the specimen before you, which was found in Monroe County, Pennsylvania.

This specimen is also interesting from the evidence it exhibits of the process of "*pecking*" (as it was called in a communication made to the Society in June, 1861), to form the cavities for the reception of the thumb on the one side, and the finger on the other. It also bears the mark of its use upon silicious minerals at each extremity; and it may, with little risk of error, be supposed to have been used in fashioning the flint arrow-heads of the *Stone Age* on the spot where it was found.

These implements are not rare in this country. A number are contained in my cabinet, and many specimens have been sent abroad for foreign exchange; but, as they present to an unaccustomed eye little difference from an ordinary pebble, it is only lately that they have attracted the attention of collectors; yet the remarks of Mr. Lyell

* Read April 15, 1864.

give evidence that they have not escaped the observation of those close and learned investigators, the archæologists of Denmark.

These implements, as far as my observation extends, have been hitherto entirely neglected in this country; but that is not so much a matter of wonder, when we know that the arrow and spear heads, so frequently found, are generally regarded as relics only, or the poor weapons, of the despised and degraded Indians, who formerly roamed in savage independence over these their hunting-grounds, with no thought of their ethnological relations or bearing on the history of the human race, and are therefore held in little esteem.

But may we not, without presumption, hazard a few remarks on a most important deduction to be drawn from the facts now being developed from examinations in nearly every part of the world? The close, nay exact similarity, of all these implements, derived as they are from regions far apart in space, in various climates, and, more singular still, from periods so remote from each other as to carry up archæology into the domain of geology; the implements of the former being so imbedded with the *debris* of the latter, that to assign a determinate age to either is probably beyond the reach of human investigation. Entirely prehistoric in their early associations, we find them, together with the bones of the great pachyderms and many other extinct animals, embedded in diluvium, in the earth and stalagmites of caves; and thence we descend from the era when these extinct monsters, the mammoth, the elephant, and the rhinoceros, and numerous rapacious beasts, held coeval possession with man of the river-banks of all climes down to the times which witness the same rude arts of the stone age practised by savages on this and it may be other continents, simultaneously with the arts of the highest civilization; when the instrumentality of the plough, the ship, and the factory furnish all that man's necessity calls for, or his most refined existence seems to need.

During all this interval man obeyed the same instinctive impulses. Even now we take a pebble (no better tool being at hand) to open a spiny chestnut burr, or to crack the shell of a nut. A savage, with no metal to aid him, makes of this pebble a more convenient tool, by pecking, with a still harder fragment of stone, cavities for his fingers; and, in a further advance, cuts a groove around it, in which he binds a *withe* handle, and then grinds its extremity to an edge, thus making the tools which serve all his limited wants, until more enlightened civilization teaches the use of metal.

Now does not all this indicate the UNITY OF HIS ORIGIN? He

naturally and inevitably follows the same course to supply his wants. He chips the flint and silicious minerals to form his spear and arrow-heads; he grinds the various stones to form his *chisels* and *axes;* he moulds the plastic clay to form his cooking utensils; and last, though not least, his aspirations for futurity indicate an innate consciousness of that great and good first cause, the Almighty hand, which formed him of the dust of the earth, and placed him in a beautiful garden, where he might have dwelt forever, if he had not fallen, by his own free will, to roam the earth,—to sink by ignorance and vice, alas! in too many cases, to that state in which STOCKS and STONES were or are his only guides or means,—the one for direction, the other for subsistence.

Stated Meeting, July 15, 1864.

Present, five members.

Mr. CHASE in the Chair.

Letters of acknowledgment were received from the Royal Society, Göttingen, January, 1864; the American Oriental Society, Boston, May, 1864, and the Lyceum of N. H., New York, March 17th, 1864.

A letter of envoi was received from the Société de Physique et d'Histoire Naturelle de Genève, March 1st, expressing a wish for full and regular exchanges, which, on motion of Mr. Fraley, was so ordered.

Letters with photographic likenesses of the authors for the Album were received from Jared Sparks, of Cambridge, Mass., May 28th, and Prof. Zantedeschi, of Padua. Mr. James presented a photograph, also, of Asa Gray, of Cambridge, Mass.

A letter to the Librarian was read from W. L. Nicholson, Esq., Topographer to the Post Office Department, correcting an error in the account of the deficiencies at Washington in the matter of United States county maps, given on page 352 of the Proceedings. Mr. Nicholson has a nearly com-

plete set of them, now on file in the United States Post Office Department, collected under the present Administration:

"On being honored with this appointment last year (coming from the Coast Survey Service), I immediately set myself to collect the best data from all quarters to have for ready reference, and to put everything into good shape, not only to keep up the current work, which is very great, owing to the changing and expanding character of the postal service, but to have the material ready for bringing out, as soon as practicable, postal maps of the United States.

"I need hardly tell you that this is a work of very great labor and nicety, your own State having over two thousand five hundred post-offices, and routes interlacing in all directions. I have more trouble with the locations of the post offices in the older States than with the new; thanks to the Land Office subdivisions.

"The Territories, however, afford choice bits of perplexity, counterbalanced, however, by the feeling of interest in the opening out and clearing up of these terræ incognitæ."

Donations for the Library were received from the Imperial Russian Government; the Imperial Geological Institute, Vienna; Royal Society, Göttingen; Dr. R. Wolf, Zurich; Société de Physique et d'Histoire Naturelle de Genève; Geological Society, Paris; the Royal, Royal Astronomical, Royal Geographical, Chemical, and Geographical Societies at London; Agricultural Society, Bath; Insane Asylums at Concord and Hartford; American Oriental Society; Silliman's Journal; New York Lyceum; Franklin Institute, Mercantile Library, Northern Home, Blanchard & Lea, and P. E. Chase, of Philadelphia; Smithsonian Institution, Census Bureau, and F. W. Seward, of Washington; and the Mercantile Library Company of San Francisco.

The Librarian called the attention of the members present to the superb volumes of the Codex Sinaiticus Petropolitanus, presented to the Society by the Imperial Government of Russia; and on motion of Mr. Fraley, the Secretaries were directed to prepare a special letter of thanks, to be signed by the officers of the Society.

The death of Mr. Benjamin Gerhard, at Philadelphia, on the 20th ult., was reported by Mr. Fraley, and Mr. E.

Spencer Miller was appointed to prepare an obituary notice of the deceased.

The death of Josiah Quincy, LL.D., at Quincy, Mass., on the 1st inst., aged 92, was announced by Mr. Lesley, and Dr. Jared Sparks was appointed to prepare an obituary notice of the deceased.

The death of Thomas Dunlap, Esq., at Philadelphia, on the 11th inst., aged 70, was announced by Mr. Fraley, and Mr. William M. Meredith was appointed to deliver an obituary notice of the deceased.

Mr. Chase read a note on the Daily Aerial Tides that are attributable to the Lunar and Solar Attraction and Variations in Temperature.

The powerful and prejudicial influence of an inveterate scientific error, is shown in the following dogmatical statement of Mr. Joseph John Murphy, an investigator who has lent useful aid to meteorological science.†

In the Edinburgh New Philosophical Journal for April, 1864, p. 183, he says: "Were the atmosphere not acted on by heat, it would be everywhere at rest, and every level surface, at whatever height, would be an isobarometric surface. . . . . . . The earth's rotation cannot produce currents, but it modifies them when they are produced by the action of heat."

There can be no doubt that heat is one of the causes, and in most places it is, perhaps, the principal cause, of those atmospheric disturbances which are modified by rotation, but the assumption that the atmosphere "would be everywhere at rest," except for differences of temperature, leads to palpable absurdities.‡

It may be freely admitted that Galileo, in attributing the ocean

* From the Proceedings of the American Philosophical Society.

† Mr. Murphy was an early and independent advocate of so much of Mr. William Ferrel's theory, as explains the polar depression of the barometer by centrifugal force and friction. Mr. Ferrel's paper, which appears to have been the first publication that contained a true explanation of the equatorial as well as the polar barometric depression, of the maxima near the parallels of 30°, and of the cause of the rotatory motion of storms, was printed in the Nashville Journal of Medicine and Surgery, and afterwards in pamphlet form, in the summer of 1856. The subject was treated at greater length, in his essay on "the motion of fluids and solids relative to the earth's surface," which was published in the "Mathematical Monthly" for 1859, vol. i, p. 140, sqq.

‡ See Proc. Am. Philos. Soc., vol. ix, pp. 283–4.

tides exclusively to "the rotation of the earth, combined with its revolution about the sun," attached too much importance to the simple combination of the motions of rotation and orbital translation, but his mistake is no greater than the opposite belief, which is now too prevalent, that there is only a single influence which can produce any important tidal effects in the atmosphere.

In a former communication on the rotation-tide, I deduced "from a reference of the aerial motions to a supposed stationary earth, a law of tidal variation nearly identical with the law that is derived from a consideration of the relative attractions of two bodies revolving about their common centre of gravity."* That such should be the case, might have been reasonably expected from the dependent connection of rotation and revolution with gravity and inertia.

I was therefore led to believe that the daily lunar barometric tides might be indicated by an expression of the same general form as the monthly lunar and daily rotation tides. On investigation I am gratified at finding that such is indeed the case. If M is the barometric mean for any given day and place, and θ is the moon's altitude, observation and theory concur in demonstrating that the lunar tide may be expressed by M C (sin. θ cos. θ),† C being a constant to be determined for each station, the principal elements of which are functions of the latitude, of gravity, and of time. I subjoin, in illustration, a

TABLE OF THE AVERAGE DAILY LUNAR BAROMETRIC TIDES.

Lunar Hours.	Station.		Lunar Hours.	Station.	
	St. Helena.	Girard College.		St. Helena.	Girard College.
	in.	in.		in.	in.
0	— .00066	+ .00313	6	— .00276	— .00308
1	— .00051	+ .00341	7	— .00242	— .00339
2	— .00172	+ .00291	8	— .00121	— .00290
3	— .00253	+ .00214	9	— .00046	— .00206
4	— .00315	— .00011	10	+ .00021	+ .00013
5	— .00330	— .00144	11	+ .00035	+ .00149

* This is evidently only another form of a single element in La Place's law of the tides. I present it in this shape, both because I obtained it independently, and because it makes the resemblance to my rotation formula more striking.

† Major-General Sabine's table of the lunar tides at St. Helena, from October, 1843, to September, 1845 (Phil. Trans., 1847, p. 48), gives for the ratios of the MEAN, .497, .832, and 1, which, if averaged with the mean at Girard College, gives a general mean of .512, .858, and 1. The GRAND MEAN for the entire periods of observation at the two stations is .500, .849, and 1.

The existence of the tidal law, which, as we have seen, should produce differences in the respective ratios of .5, .866, and 1, at 1, 2, and 3 hours from the mean tide, is shown in the following

TABLE OF TIDAL DIFFERENCES AND RATIOS.

Stations.	Lunar Time.	Differences of Barometer.			Ratios.		
		1 h.	2 h.	3 h.	1 h.	2 h.	3 h.
St. Helena, 1841–46.	Before 2 h.	.00121	.00166	.00207	.585	.802	1
	After 2 "	.00081	.00143	.00158	.501	.905	1
	Before 8 "	.00121	.00155	.00209	.579	.742	1
	After 8 "	.00075	.00142	.00156	.481	.917	1
	Mean, . .	.00099	.00151	.00182	.545	.830	1*
	Mean Ratios,				.536	.841	1
Girard College, 1842–44.	Before 4 h.	.00225	.00302	.00352	.639	.858	1
	After 4 "	.00133	.00297	.00328	.405	.905	1
	Before 10 "	.00219	.00303	.00352	.602	.861	1
	After 10 "	.00136	.00300	.00328	.415	.915	1
	Mean, . .	.00178	.00300	.00340	.524	.884	1
	Mean Ratios,				.515	.885	1
Grand Mean, or Average of Mean Ratios, . .					.525	.863	1

By a partial interpolation for the true time of mean tide at St. Helena, I obtain for the ratios of the means .557, .866, and 1, corresponding precisely with theory at 2h. from mean tide. The tables furnish suggestive evidences of the effect of declination, the varying tidal influence of attraction, when acting with and against rotation, and the resistance of gravity to the tidal flow of air.

The rationale of M. Flaugergues' second and third inferences thus becomes intelligible; the phenomena of ocean tides are connected with those of the atmosphere, which are subject to fewer extraneous disturbing influences, and can therefore be more easily investigated; and the long-suspected obedience of the principal meteorological changes to fixed natural and mathematical laws, is at length made evident.

There are, therefore, manifestly four important causes of barometric disturbance: 1, rotation, with its quarter-daily phases of alternate aid and opposition to the attraction and temperature-currents, and of shifting the aerial particles to levels of greater or less density; 2, variations of temperature and vapor; 3, lunar attraction; 4, solar attraction. Among the subordinate causes, perhaps the next in order of importance is, 5, resistance of the æther, which, according

to Fresnel's theory,* is subject to the laws of inertia and attraction, as well as to those of elasticity. If his theory is correct, the terrestrial æther (or the portion which partakes of the earth's rotation), may be so modified by the planetary æther (or the portion which revolves about the sun), as to produce a resistance varying at different hours, and a consequently varying atmospheric compression, which may some time enable us to measure its own density. The solar attraction may be constantly tending to accumulate the terrestrial æther, as well as the atmosphere, in a spheroid with a major axis in the line of the radius vector, and the position of the axes, as in the case of the ocean and aerial spheroids, may be modified by rotation. It appears to me that one of the most probable results of the rotation of the earth with its atmosphere, in an æthereal medium, would be the production of two systems of oscillations, moving with the rapidity of light, one in the line of the earth's orbit, and the other in the line of its radius vector, and that those systems would be constantly so related that while one tended to retard, the other would tend to accelerate the earth's motion.

The influences of rotation and attraction can be calculated, and after deducting their amount, the problem of accounting for the residual disturbance will be simplified. Or, by taking the average of a long series of observations made at each hour of the solar day, the effects of lunar attraction may be so far eliminated, that they can be safely disregarded in attempting to fix the approximate value of the other principal disturbances.† The formula for the rotation tide has already been given, and observation appears to indicate that it is retarded about an hour by inertia; next in order of importance are the temperature and vapor tide, and the solar tide. It would be presumptuous in the present stage of our investigations, to attempt to fix the precise amount of disturbance which is attributable to each of these two tides, but from the following considerations we may derive

* It is, perhaps, hardly proper to call this "Fresnel's theory," since it follows necessarily from the conception of an extremely tenuous and elastic material fluid, such as the æther is generally supposed to be. But I believe M. Fresnel has done more than any one else to show the agreement of the hypothesis with observed phenomena, and his labors deserve to be kept in honorable remembrance.

† The absence of any long series of observations at each hour of the lunar day, prevents our eliminating the effects of solar attraction in a similar way. Nevertheless, I propose at some future time to attempt the elimination, so far as practicable with the tables at my command, in the hope of thereby effecting a more accurate determination of the temperature and vapor tide.

conjectural results, which appear to me to be more satisfactory and philosophical than any that have been heretofore obtained.

The theoretical maxima of the rotation tide, allowing an hour for the lagging of inertia, occur at 4h. and 16h.; the minima, at 10 h. and 22h. The solar attraction maxima, with the same allowance, should be found at 1h. and 13h.; the minima, at 7h. and 19h. If we assume that the attraction tidal curve is symmetrical, and regard all the deviations from symmetry as occasioned by differences of temperature and vapor, we may readily construct the following approximate

DAILY BAROMETRIC TIDAL TABLE.

	Girard College, 1842–44. Mean Height, 29.938 inches.*				St. Helena, 1844–46. Mean Height 28.2821 inches.			
Astronomical Time.	Observed Height 29 inches +	Rotation Tide.	Temperature and Vapor Tide.	Solar and Residual Tide.	Observed Height 28 inches +	Rotation Tide.	Temperature and Vapor Tide.	Solar and Residual Tide.
h.		in.	in.	in.		in.	in.	in.
0	.943	+.0126	—.0031	—.0045	.2985	+.0149	+.0035	—.0020
1	.927		—.0055	—.0055	.2819		+.0021	—.0023
2	.915	—.0126	—.0059	—.0045	.2660	—.0149	+.0008	—.0020
3	.909	—.0217	—.0058	—.0015	.2553	—.0258	—.0003	—.0007
4	.908	—.0252	—.0053	+.0005	.2521	—.0298	—.0010	+.0008
5	.911	—.0217	—.0075	+.0022	.2562	—.0258	—.0015	+.0014
6	.917	—.0126	—.0124	+.0040	.2642	—.0149	—.0040	+.0010
7	.925		—.0170	+.0040	.2764		—.0067	+.0010
8	.935	+.0126	—.0196	+.0040	.2899	+.0149	—.0081	+.0010
9	.942	+.0217	—.0199	+.0022	.3003	+.0258	—.0090	+.0014
10	.945	+.0252	—.0187	+.0005	.3061	+.0298	—.0066	+.0008
11	.946	+.0217	—.0122	—.0015	.3025	+.0258	—.0047	—.0007
12	.941	+.0126	—.0051	—.0045	.2913	+.0149	—.0037	—.0020
13	.938		+.0055	—.0055	.2777		—.0021	—.0023
14	.935	—.0126	+.0141	—.0045	.2646	—.0149	—.0006	—.0020
15	.933	—.0217	+.0182	—.0015	.2562	—.0258	+.0006	—.0007
16	.934	—.0252	+.0207	+.0005	.2550	—.0298	+.0019	+.0008
17	.940	—.0217	+.0215	+.0022	.2611	—.0258	+.0034	+.0014
18	.950	—.0126	+.0206	+.0040	.2737	—.0149	+.0055	+.0010
19	.959		+.0170	+.0040	.2898		+.0067	+.0010
20	.966	+.0126	+.0114	+.0040	.3048	+.0149	+.0068	+.0010
21	.968	+.0217	+.0061	+.0022	.3163	+.0258	+.0070	+.0014
22	.967	+.0252	+.0033	+.0005	.3184	+.0298	+.0057	+.0008
23	.958	+.0217	—.0002	—.0015	.3117	+.0258	+.0045	—.0007

Imperfect as these first approximations confessedly are, and probable, nay, almost certain though it be, that a large portion of the residual tide should be transferred to the temperature and vapor column,† yet

* The sum of the tides, + the mean height = observed height.

† I can see no good reason at present, for supposing the existence of a solar tide greater than .002 in., which would be equivalent to .0005, .0009, and .001, at 1,

I think the above table will be found suggestive of valuable inferences, of which the following are perhaps among the most important.

1. That the apparent osculation of the solar and residual curve near the hours of high barometer may perhaps be owing to æthereal resistance.

2. That the cumulative action of the sun upon the air and æther, may possibly render the disturbing influence of its attraction upon the atmosphere even greater than that of the moon.

3. That the paradoxical assumption of those who advocate the temperature theory of the quarter-daily tides, that a dependent relation can exist between the barometrical changes and the changes of temperature, which "appears to be DIRECT during the morning hours, and INVERSE during those of the day and evening,"* is unnecessary, useless, and unphilosophical.

4. That in intertropical and medium latitudes, the average daily barometric tide which is attributable to variations of temperature is smaller than the rotation tide.

5. That there is but one high and one low temperature tide in twenty-four hours.

6. That the effects of temperature upon atmospheric pressure reach their maximum in the evening, when the aerial absorption of heat from the sun ceases to be in excess of its radiation, and their minimum in the morning, when radiation ceases to be greater than absorption.

7. That the daily temperature tide increases, while the rotation tide diminishes, as we approach the poles.

8. That, in consequence of rotation, there should be a slight tendency to vertical ascending currents at 4h. and 16h., and descending currents at 10h. and 22h.

9. That whatever modifications the table may require, there can be no doubt of the existence of the three tides, with maxima and minima near the times specified, or of the possibility and desirability of accurately determining their magnitude.

2, and 3 hours from the mean tide. This would reduce the quarter-daily residual tide at St. Helena, to the following form :

1h.	2h.	3h.	4h.	5h.	6h.	7h.
—.0033	—.0029	—.0012	+.0008	+.0019	+.0019	+.0020

If this residual be added to the preceding column, it gives a result accordant with the 6th inference, except two disturbances, which, I think, can be easily explained, one at midnight, and the other in the hottest part of the day.

* James Hudson, Phil. Trans., 1832.

The phenomena on which these inferences are based, are all susceptible of a simple and obvious explanation, and thus, by reasoning alternately *à priori* and *à posteriori*, we elicit from a scheme of seemingly lawless confusion, the beauty of a most marvellous order.

Pending nominations Nos. 522, 523, 524, 525, were read, and balloted for.

Mr. Fraley, Chairman of the Finance Committee, moved that the Committee have authority to compromise the claim of the Society on the bond of Charles Wharton, secured by a mortgage on certain coal lands in Northumberland County, for a sum not less than four thousand (4000) dollars, and that, in the event of such compromise and settlement, the officers of the Society be authorized and directed to execute and deliver such instruments of writing as may be necessary to carry the compromise into effect, and affix and attest the seal of the Society thereto. The motion was passed unanimously.

On motion of Mr. Fraley, the sum of five hundred (500) dollars was appropriated to the Committee on the Hall for the purpose of meeting expenses incurred in the late repairs of the building, and moreover the sum of one hundred (100) dollars for binding books.

There being no further business before the Society, the ballot-boxes were examined by the presiding officer, and the following persons declared duly elected to membership in the Society:

Joseph Harrison, Esq., of Philadelphia.
John Foster Kirk, Esq., of Boston, Mass.
Prof. George H. Cook, M.D., of New Brunswick, N. J.

And the Society was adjourned.

Stated Meeting, August 19, 1864.

Present, seven members.

Judge SHARSWOOD, Vice-President, in the Chair.

A letter accepting membership was received from M. Morlot, dated Lausanne, 20th April, 1864.

A letter acknowledging publications was received from the Massachusetts Historical Society, Worcester, July 1st, 1864.

Letters of envoi were received from the Minister of Agriculture, &c., Paris, January 29th, and from the Light-house Board, Treasury Department, Washington, August 6th, 1864.

A letter requesting missing Proceedings was received from the Society of Antiquaries, London, July 15th, 1864.

Letters were read from Prof. Matile at the Smithsonian Institution, respecting thirty-four pieces from the archæological collection of the Society, casts of which are to be taken for general distribution.

A circular letter was received from E. Corter, Paris, June 21st, respecting the Annuaire of Count d'Hericourt.

A letter was received from Mr. Miller accepting his appointment to prepare an obituary notice of Mr. Gerhard, and one from Dr. Sparks excusing himself from his appointment to prepare an obituary notice of Mr. Quincy. On motion of Mr. Fraley, Mr. Everett was appointed in his stead.

Donations for the Library were received from M. v. Morlot, the Royal Astronomical and British Meteorological Society, the American Antiquarian and New Jersey Historical Societies, the Rensselaer Polytechnic and Franklin Institutes, Mr. Chase, Blanchard & Lea, Prof. Whitman, of Centre County, Pa., Col. Bache and the Light-house Board, the Superintendent of Public Instruction in California, and Santa Clara College, San Francisco.

Mr. James expressed his own and Mr. Lesquereux's satisfaction at the speedy publication of the first article in the XIIIth volume of the Transactions, on Californian Mosses; as its opportune distribution abroad had compelled the substi-

tution of American names, for English and German names already in the press and about to be fixed upon this interesting part of the present American Flora.

Mr. Chase stated that he looked with much interest for the confirmation of his views in regard to barometric fluctuations, from the investigations which M. Le Verrier, in his letter of June 8th, has proposed to undertake. The letter was communicated to the London Athenæum of June 25th by Admiral Fitzroy.

Mr. Lesley described, from private letters, the more recent discoveries of Prof. Desor, of Neuchâtel.

In April last, M. Desor's assistant, Mr. Benz, brought in from one of the localities of lake habitations, known as the "iron station," the first genuine human skull. M. Desor describes this skull as of a type as low as that from the Neanderthal cave, with slanting forehead and enormous circumorbital bones. Yet it undoubtedly belonged to a Helvetian, and one of large stature, for with it were obtained many Helvetian coins, lance-heads, &c., and four swords in ornamented scabbards.

In May, M. Desor carried out his long-entertained purpose of examining the Bavarian lakes, said by the German naturalists to contain no trace of *pilotis* remains; theories having been constructed to account for this curious limitation of the *pfahlbauten* to Switzerland. M. Desor visited his friend, Prof. v. Liebig, with assured confidence that all such theories were founded on a prime error of fact. In company with Mr. Benz and Prof. v. Siebold, the distinguished palæontologist of Bavaria, he visited the Lake of Starnberg, three Swiss miles from the capital, in which is an islet called the Isle of Roses, supporting the summer palace of the King. At the end of this islet, and running underneath it, *proving it to be artificial,* they found multitudes of piles, so well preserved that the rings of growth could be read; and among them quantities of antique pottery and cleft marrow-bones of five species of animals, among which were the horse, cow, stag, and hog. The excitement at Munich was very great; and the young King's government established a commission with v. Siebold at its head, who have explored already five of the Bavarian lakes, and discovered in them seven stations of lacustrine habitations, from which numerous relics of the *bronze* age also have

been dredged up, showing that it was synchronous or closely continuous with the so-called preceding Age of Stone.

Dr. Coates observed that, as he apprehended, well-known historical documents were omitted to be noticed, which yet bear upon these subjects. The transition from the brass to the iron age is indicated by Horace, and appears to have taken place, as in the migrations of the Dorians, with few if any battles. The heroes of the Iliad fight with large stones. A high state of civilization existed at the same time, as in the mention of Phoenicea, Mycenæ, and Tyre. A population being driven into a lake, and founding even a mighty city there, is exemplified by Mexico, according to the hieroglyphic records abstracted by Clavigero. Venice, also, though not situated in a lake, is a case of much analogy.

Dr. Coates reminded the Society of the general omission, as a fact in the history of the later geological age, of the narrative in Genesis of the destruction and deep depression of the cities and cultivated plain of Sodom, although preceded by the account of a great battle, with mention made of nine names of cities and eight of commanders, and connected with the account of Abraham, Lot, and Melchisedek.

Pending nomination No. 525, and new nominations Nos. 526, 527, 528, were read.

And the Society was adjourned.

Stated Meeting, September 16, 1864.

Present, eight members.

Mr. LEA, Vice-President, in the Chair.

Letters accepting membership were received from Mr. J. F. Kirk, dated Dorchester, Massachusetts, August 25th; and from Dr. Louis Stromeyer, dated Hanover, July 25th, 1864.

A letter resigning membership was received from Mr. E. E. Law, dated Philadelphia, September 10th, 1864. On motion his resignation was accepted.

A letter asking to be excused from writing another

obituary notice of Mr. Quincy was received from Mr. E. Everett, dated Boston, August 27th, 1864. On motion Mr. Everett was excused.

Photographs for the Album were received from Dr. W. S. W. Ruschenberger, Professor W. Chauvenet, Dr. L. Stromeyer, and Dr. Isaac Hays.

Letters of acknowledgment were received from the Asiatic Society of Bengal, Calcutta, October 3d, 1863; the Corporation of Harvard College, August 22d, and Captain Gilliss, Washington, August 20th, 1864.

Letters of envoi were received from the Smithsonian Institution, and Mr. J. W. Irwin, of New York City.

Donations for the Library were received from Dr. Stromeyer; the Annales des Mines; the London Society of Antiquaries; Harvard College; Silliman's Journal; the Brooklyn Mercantile Library Association; Messrs. Blanchard & Lea, and Mr. Eli K. Price, of Philadelphia.

Mr. Lea made a communication of a discussion of "Prime Right-Angled Triangles and $\sqrt{2}$," from a private letter addressed to him from Dr. James Lewis, of Mohawk, New York.

Prime Right-Angled Triangles, and $\sqrt{2}$.

In any R. A. Triangle, let $H =$ hypothenuse, $P =$ perpendicular, $B =$ base.

Then $H^2=P^2+B^2$; whence $H^2-P^2=B^2$. H^2-P^2 is the product of two factors, $H+P$ $(=a)$ and $H-P$ $(=b)$. Accordingly,

$$H^2-P^2=(H+P)\times(H-P)=ab=B^2, \quad \text{and } \sqrt{ab}=B.$$
$$a+b=(H+P)+(H-P) \quad =2H \quad \text{and } \frac{a+b}{2}=H.$$
$$a-b=(H+P)-(H-P) \quad =2P \quad \text{and } \frac{a-b}{2}=P.$$

The radical sign before ab implies that the terms a and b are squares; the fractional expressions $\frac{a+b}{2}$ and $\frac{a-b}{2}$ implies that those terms should be multiplied by 2. Substituting for the terms a and b, others that meet these indications, viz., $a=2N^2$ and $b=2S^2$, the sides of R. A. Triangles have the following general expression: $H=N^2+S^2$, $P=N^2-S^2$, $B=2NS$. If the terms N and S be any whole numbers, their expansion as indicated in the formula, will evolve the sides of Prime Right-Angled Triangles (prime, in the sense that the tri-

angles thus evolved may be analyzed without the introduction or suppression of factors). If in the above formula for prime R. A. Triangles, $x+y$ be substituted for N, and y for S, the following formula will appear: $H=x^2+2\times y+2y^2$, $P=x^2+2\times y$, $B=2\times y+2y^2$. This second formula will be chiefly referred to in the following summary:

DECOMPOSED FRACTION OF THE SQUARE ROOT OF 2.

$$\sqrt{2}=1+\cfrac{1}{2+\cfrac{1}{2+\cfrac{1}{2+\cfrac{1}{2+1}}}} \ \&c. = \underset{(\triangle}{\frac{1}{1}} = \frac{3}{2} = \underset{\triangle}{\frac{7}{5}} = \frac{17}{12} = \underset{\triangle}{\frac{41}{29}} = \frac{99}{70} = \underset{\triangle)}{\frac{239}{169}} \ \&c. \quad \triangle = \frac{x}{y} = \frac{B+P}{H}$$

$$\frac{B+P}{H} = \frac{x}{y} = \sqrt{2} \text{ approx.}$$

x		y
1	△	1
3		2
7	△	5
17		12
41	△	29
99		70
239	△	169

The decomposed fraction of $\sqrt{2}$, when resolved into a series of numerators and denominators of common fractions $(\frac{x}{y})$ will present the values in the annexed table, column x embracing numerators, and column y the corresponding denominators. The first two terms, or INITIALS of the series, being found, succeeding terms may be found by additions, observing the following relations, $x+y=y'$, $y+y'=x'$, $x'+y'=y''$, $y'+y''=x''$, &c., continuously; or, $y+2y'=y''$, $y'+2y''=y'''$, $y''+2y'''=y''''$, &c.

In this series it will be seen that each alternate fraction (△) embraces a triangle in the form $\frac{B+P}{H}$ in each one of which triangles is a *common characteristic*, having the expression $B-P=\pm 1$.

An analysis of the several triangles of this series, by means of the formula embracing the terms x and y, will reproduce the series of values of x and y respectively, as given in the table. This is the only series which will reproduce its radical elements, for the reason that $\sqrt{1}=1$; and the root of no other quantity than 1 is equal to itself. If the several triangles be analyzed by the formula embracing the terms N and S, N and S will successively reproduce the series of denominators y, N being in advance of S.

The general character of this and any similar series of triangles, suggests the expression "$\frac{B+P}{H}=\sqrt{2}$ approximately." Other series of triangles similarly derived from different *initials* will confirm this suggestion.

The intermediate alternate terms in the series (not distinguished by the sign $\triangle$) are only approximately R. A. triangles, having the character which may be inferred from the following expression, $B^2+P^2=H^2\pm 1$.

The preceding table, derived from the *initials* "1, 1," presents a series of approximate common fractions of the square root of 2, a quantity that can only be approximately expressed in limited terms. As expressions of the value of the root of 2, the successive fractions present discrepancies which have peculiar relations to $\sqrt{1}$ or 1. Other series similarly derived from other initials, will, in a similar manner, be approximate fractions of $\sqrt{2}$, but each series will have its characteristic discrepancy, which is related to the series as $\sqrt{1}$ or 1 is to the series just considered. This discrepancy will appear in any series as the quantity D in the expression $B-P=\pm D$, which expression is the *characteristic* of all the R. A. *triangles* of a series.

$\frac{x}{y}=\sqrt{2}$ approximately

x		y
1	$\triangle$	2
5		3
11	$\triangle$	8
27		19
65	$\triangle$	46
157		111
379	$\triangle$	268

The annexed series exhibits proportions similar to those of the preceding. The characteristics of the triangles in the alternate terms ($\triangle$) in the form $\frac{B+P}{H}$, is $B-P=\pm\sqrt{7}$. The *approximate* R. A. triangles (not designated by the sign $\triangle$) may be characterized by the expression $B^2+P^2=H^2\pm\sqrt{7}$. The successive fractions $\frac{B+P}{H}$ regarded as approximations to $\sqrt{2}$, present discrepancies which are related to $\sqrt{7}$ or 7 as the discrepancies of the preceding table are related to $\sqrt{1}$ or 1.

The triangles evolved by expanding the successive values of x and y, as in the formula embracing those terms, have the characteristics $B-P=\pm 7$.

This table having been derived from the initials "1, 2," by additions, may be continued backwards by subtractions, which will develop a series of terms, among which negative quantities will appear. The first pair of terms (x and y) in which a negative quantity appears, may be regarded as the *initials* of a new series, *correlative* to that from which it is derived. The *initials* being found may both be regarded as positive, and the series extended by additions, as in the preceding instances.

$x-y=y_,$. $y-y_,=x_{,,}$ $x_,-y'=y_{,,}$ &c. $x_,=+3$. $y'=-1$, the initials of the series.

$\frac{x}{y} = \sqrt{2}$ approximately

x		y
3	—	1
5	△	4
13	—	9
31	△	22
75	—	53
181	△	128

The annexed series is the *correlative* of the last preceding, and is in all respects similar, except that it is derived from different initials. Either series being given, the other may be found in the manner suggested.

In any case when a series has a *correlative*, it may be found in the same manner. In any instance in which D in the expression $B—P=\pm D$, is a prime number, or a multiple of a prime number, and the triangle to which the expression refers, is a Prime Right-Angled Triangle, as previously defined, an analysis of the triangle by the formula embracing the terms x and y, will give values for x and y, which may be extended into a series, which series has its correlative, as in the preceding instance. If D is found to embrace several factors which are prime numbers, each one of those prime factors may be found to give rise to two series of values for x and y, which will be correlative to each other, so that there will be twice as many series of values of x and y as there are prime factors in D, and accordingly twice as many series of R. A. Triangles in which $B—P=\pm D$ as there are prime factors in D.

If D is the square of a prime number, there will be three series of values for x and y, two of which will be *correlative* to each other, the initials of the third being $x=y=\sqrt{D}$.

Other generalizations might be suggested co-ordinate with these, which, however, are yet incomplete, and are reserved for further consideration.

If any prime R. A. Triangle be resolved into the fractional form $\frac{B+P}{H}\left(=\frac{x}{y}\right)$ and a series of fractions be derived therefrom by additions or subtractions, as in the preceding illustrations, the alternate corresponding values of x and y in the series will embrace a Prime R. A. Triangle in the form $\frac{B+P}{H}\left(=\frac{x}{y}\right)$, and all such triangles in the series will have the same value for D in the expression $B—P=\pm D$. If the series of values of x and y thus tabulated be expanded into a series of triangles (by means of the formula embracing x and y) the triangles thus evolved will be characterized by the expression $B—P=\pm D^2$, (D referring to its value in the former instance.)

Any whole numbers whatever, when used as the initials of a series under x and y, as in the preceding illustrations, will develop a series of numerators x and denominators y, of *common fractions ap-*

proximating $\sqrt{2}$, each alternate numerator embracing B+P and its corresponding denominator H of some R. A. Triangle, in which the difference of B and P will be the square root of some whole number which will characterize the series; and the numerical value of B—P, will have the same relation to the series that $\sqrt{1}$ has to the series derived from the initials "1, 1" in the first illustration. From the various considerations here presented, is derived the general inference $\frac{B+P}{H}=\sqrt{2}$ approximately.

JAMES LEWIS,
Mohawk, N. Y., August 31, 1864.

Mr. Chase read a communication "On the Comparative Fitness of Languages for Musical Expression;" presenting the results of an investigation that had been suggested by the remarks of Mr. Foulke, at a previous meeting of the Society.

The fitness of any language for musical expression, depends, not on the number and character of the letters, but on the sounds that are expressed by their several combinations. I have, therefore, thought that it would be interesting to analyze the sounds, and to institute a variety of comparisons between Italian, French, English, and German, in order to determine as nearly as possible the precise nature of their harmonic differences.

In making my comparisons, I selected a number of the principal poets in each language, and examined a few passages from each. From the aggregates I framed the following Tables:

1. Number of sounds of each description in 10,000 syllables.

Sounds.	Italian.	French.	German.	English.
Vowel, . .	10,207	10,355	10,778	11,439
Nasal, . .	1,957	2,928	3,547	2,952
Liquid, . .	2,806	2,883	3,419	3,348
Sibilant, . .	1,597	2,436	2,113	2,643
Labial, . .	1,389	2,385	1,899	1,982
Dental, . .	2,532	2,132	3,626	4,266
Guttural, . .	969	863	2,341	1,351
	21,457	23,982	27,723	27,981

2. Proportion of sounds in a given number of ideas.

Sounds.	Italian.	French.	German.	English.
Vowel, . .	10,207	8,845	9,765	9,579
Nasal, . .	1,957	2,502	3,214	2,472
Liquid, . .	2,806	2,467	3,098	2,804
Sibilant, . .	1,597	2,084	1,914	2,213
Labial, . .	1,389	2,041	1,720	1,660
Dental, . .	2,532	1,825	3,285	3,572
Guttural, . .	969	738	2,121	1,131
	21,457	20,502	25,117	23,431

3. Number of sounds of each description in 10,000 sounds.

Sounds.	Italian.	French.	German.	English.
Vowel, . .	4,757	4,312	3,888	4,088
Nasal, . .	912	1,221	1,279	1,055
Liquid, . .	1,308	1,204	1,233	1,197
Sibilant, . .	744	1,017	762	945
Labial, . .	648	996	685	708
Dental, . .	1,180	890	1,308	1,524
Guttural, . .	451	360	845	483
	10,000	10,000	10,000	10,000

It appears, therefore, that

1. In a given number of syllables, English has the greatest number of sounds, and Italian the least.

2. In the expression of a given number of ideas, German uses the greatest number of sounds, and French the least.

3. Italian is the richest in the most musical sounds, or the vowels and liquids,—German in the nasals and gutturals,—French in the sibilants and labials,—and English in the dentals.

4. In regard to the harshest and least musical sounds, German has an excess of gutturals, French of sibilants, and German of gutturals and sibilants combined.

5. German has the greatest proportion of mute, and the smallest proportion of vocal and semi-vocal sounds, and is, therefore, the least musical of the three languages.

Mr. Chase also read a communication "On Certain Primitive Names of the Supreme Being."

The resemblance between Algonquin "Manitou," Chinese mang

taou, Egyptian ma ntr, Latin magnus deus, Greek *μέγας θεός*, and Sanscrit maha deva, to which I made casual reference in a former communication (Trans. A. P. S., New Series, vol. xiii, p. 61), has seemed to some of my friends sufficiently interesting and important to justify a more minute and analytical exposition. The last three forms are confessedly cognate; the resemblance between the others is at least equally striking, and were it not for the wide geographical separation of the nations, and the absence of any direct evidence of intercourse, we should naturally suppose that they were derived from the same original source. But since it would be difficult to select three languages that are less likely to have sprung from a common parentage, it is reasonable to expect that the coincidence will be severely criticized by those whose prejudices forbid a belief in the unitary origin of man, and that little regard will be paid to the mathematical probability of any hypothesis that may be supposed to weaken its significance.

The Chinese corresponds precisely in meaning with the Aryan forms, but the extent of the correspondence in the Algonquin and Egyptian words, is somewhat uncertain. The probability that it is equally complete in Algonquin, is strengthened by the considerations that, 1, the Indian tribes generally speak of the Deity as the "Great Spirit;" 2, the Shyenne word for spirit is mahio; 3, the Algonquin forms mechekelo, miss, michau,—Blackfoot omuku, omaesin,—Cushna muck,—Shyenne tsimahaa,—all signify "great," and all contain the root ma, variously modified, as in C. mang, S. maḥ, L. magn-, mag-, Greek *μεγ-*, *μακ-*, E, mass, much, many, &c., &c. In Egyptian, ma ntr is properly "the true God," naa ntr being equivalent to "magnus deus." But m and n are often interchanged; the root na or naa is found in Arapoho benasa, *large*, naathia, *so large;* some of the subordinate meanings of ma are retained in Egyptian mh or mah = Ch. mang, *to fill*, and in mak = L. mag-, *to rule;* and a probable association between the ideas of truth and greatness is shown by S. uru, G. ur, L. verus, E. very, &c.

It is probable that tr and taou are both compounds, and that they may have both been originally identical in meaning, and perhaps also in form, is shown by S. tr, trai, *to conquer*, *to prescrve*, *to guard;* Pawnee terahu or tidihu, *great*, terawa, *god* (Cfr. also Eg. ra, *the sun;* S. raviˢ, *the sun*, ràdȷ, *to govern*, racſ, *to guard*, I'svaraˢ, *God;* Crow, isa, *large*).

The Chinese and Indian languages appear to furnish a clue to

some of the other primitive names of the Supreme Being. The root aou, *to shine* (which is in its organic formation, as well as in its significance, almost identical with r), is found nearly pure in C. haou, *appearance of the sun rising, the light of the heavens;* M. 3252–4, gaou, aou or yaou, *the light of the sun*, M. 2932; Iowa, hawe, *day;* Eg. auu, *splendor*, aui, *to glorify;* H. אור, *light;* L. aurora, Y. auro, *morning*. The same root is traceable, with some slight modifications, in C. ou or woo, *bright*, M. 11747, yaou, *very white, the splendor of the sun*, M. 11965, 11973, yuh, *the splendor of the sun*, M. 11870, heu or yu, *the air extending itself, great, warmth, sunlight, morning*, M. 3738–41, 3756–7, tsaou, *morning*, M. 10540, chaou, *the splendor of the sun, daylight*, M. 349, 1459, keaou, *white*, M. 5578, we or wei, *the light of the sun*, M. 11661, wang, *the sun going forth and shedding his illuminating beams*, M. 11620, paou, *the fierce rays of the sun;* D. wi, *the sun*, aŋpao, *dawn, daylight;* Assiniboin, aumpa, *day;* Pawnee, tewauwaupits, *lightning;* Shyenne, iwonit, *the moon rising*, iniwooniyots, *day breaking*, wowoiwo, *morning star;* Algonquin, kayshoh ("the mighty Yoh" = magnus Jov- = Shyenne mah-io), *sun, day;* S. dȷval, *to blaze*, dyu, *to shine*, dyauṣ, *the bright heaven;* Gr. ἕως, L. Eurus, C. heuh, *the light of the morning*, M. 3857.

Material existence is principally manifested through the medium of light, and accordingly we find C. we or wei, *to be*, M. 11640, yew, *existence*, M. 12107; Eg. au, *to be;* Alg. iah, iau, *to be, to do, to have;* Chaldee, yáo;* H. יה, יהוה; Ger. wesen; E. was. Prof. Max Müller has well shown the connection of deus, deva, θεός, Ζεύς, with S. dyauṣ, and the resemblance of the Hebrew ה, יהוה on the one side to Alg. iah, iau, and on the other to L. Ju-, Jov-, has been pointed out by different writers, but I think no one has shown how readily all these forms may be connected through the Chinese heaou, *vapor, breath*, M. 3556, 3580; yaou, *the glory of the sun*, M. 11965; yew, *existence;* teaou, *the sovereign or watchful yaou*, M. 9992, 10004; teaou, *to look to a distance, a species of dragon*, M. 10031, 10045;† taou, *the principle from which heaven, earth, man, and all nature emanates.* According to Morrison, "Taou, in the books of Laou tsze, is very like the *Eternal Reason.*

* See Bunsen's Egypt, vol. iv, p. 193–4.

† Cfr. S. drç, Gr. δέρκω, L. draco (= "the Watcher"). The dragon is the badge of the Emperor of China, and is embroidered or painted on his standards, "in the manner of the ancient Scythians, Parthians, Persians, and Romans." The basilisk was also the emblem of the sun-god and of the monarch in Egypt.

of which some Europeans speak; *Ratio* of the Latins, and the *Logos* of the Greeks." The resemblance between Mexican Teo and Greek θεός, has been often noticed, but it has usually been dismissed as a merely accidental, though curious coincidence. In comparison with the analogues here given, it assumes a new importance.

The association of the ideas of whiteness, purity (πῦρ), brilliancy, divine glory, and sacrifice, may perhaps account for such resemblances as C. yang, *a sheep or goat*, *fire burning fiercely*, *bright*, *splendid*, *the sun*, *male*, *the superior of the two material principles into which, according to the Chinese, chaos was divided;* S. yas, *light*, *lustre*, adjas, *a goat*, yadj, *to sacrifice*, agni, a̧gati, *fire;* L. agnus; Gr. αἴξ; Y. ake, *a goat*, agutaŋ, *a sheep*, ako (= Eg. ka), *male*, eraŋ, *a sheep* (raŋ, yaŋ, saŋ, *to shine*, *to burn*, *brilliantly*); D. saŋ, *whitish or yellowish*, agu, *to burn on or on account of anything*, wiyakpa, iyoyaŋpa, *to shine*, aŋpao, *day*, takiŋ-wanuŋ-yaŋ-pi (= "deer-accidentally-domesticated*-flock") *sheep;* Mandan, aŋsa-kte (= "the great aŋsa"), *mountain sheep*. The Shyennes call the sheep "the white deer."

Some of the Chinese religious expressions appear to furnish traces of the remains of an early inspiration, as well as a parallelism of thought that is indicative of a common origin. For example, by combining the two characters which represent *my* and *sheep*, the Chinese form the character for e, *good*, *right*, *suitable*, *righteousness*. Morrison says (under the word "light"), "The Budhists speak of a light within; thus of the principles of the Kin Kang King, they say, 'This sacred book is originally possessed by all mankind in their own nature, unperceived by themselves. When they are awakened to know their own hearts, they are assured of the internal scripture. Having the light within, they do not, like the men of the world, seek for Budh outside their own persons, nor seek for a scripture externally, but rouse the internal mind, and adhere to the internal mental scripture.' Does not this language resemble that of the Friends, called Quakers?"

Some of the latest triumphs of physical science have led to the revival of beliefs nearly identical with the intuitive or inspired perceptions of our early ancestors, as manifested in their worship of the mysterious Agency that controls the Universe. Thus we find in

* The Chinese speak of the lew chŭh, the "six domestic animals," ma, *the horse* (Cfr. G. mahre, E. mare), new, *the cow* (Cfr. Sw. nöt, Dn. nöd, W. cnud, E. neat), yang, *the sheep*, ke, *the fowl* (the "caller"), keuen, *the dog* (Cfr. S. çvan, Gr. κύων), che, *the hog* (Cfr. F. cochon).

Tyndall's lectures on "Heat considered as a mode of motion" (First American Edition, p. 446, sqq.), such expressions as the following: "Every mechanical action on the earth's surface, every manifestation of power, organic and inorganic, vital and physical, is produced by the sun. . . . . He blows the trumpet, he urges the projectile, he bursts the bomb. And remember, this is not poetry, but rigid mechanical truth. He rears, as I have said, the whole vegetable world, and through it the animal; the lilies of the field are his workmanship, the verdure of the meadows, and the cattle upon a thousand hills. He forms the muscle, he urges the blood, he builds the brain. His fleetness is in the lion's foot; he springs in the panther, he soars in the eagle, he slides in the snake. He builds the forest, and hews it down; the power which raised the tree and which wields the axe being one and the same. . . . The sun digs the ore from our mines, he rolls the iron, he rivets the plates, he boils the water, he draws the train. He not only grows the cotton, but he spins the fibre and weaves the web. There is not a hammer raised, a wheel turned, or a shuttle thrown, that is not raised, and turned, and thrown by the sun." No Chinese Bonze, no Hindoo Brahmin, no Persian Fire-worshipper, no Egyptian, Grecian, or Roman priest, no Indian medicine-man, could have discoursed in more eloquent language of the power of the "Mighty Ra" or "Yau," and none perhaps, with less danger of inculcating the belief, that the mere inert material nature can exert that all-controlling power which is essentially spiritual, and can spring only from a Supreme Intelligence.

Pending nominations Nos. 525, 526, 527, 528, were read.

And the Society was adjourned.

Stated Meeting, October 7, 1864.

Present, sixteen members.

Dr. Wood, President, in the Chair.

A letter accepting membership was received from Mr. Joseph Harrison, dated Philadelphia, September 24th, 1864.

A letter acknowledging the receipt of publications was re-

ceived from the New York State Library at Albany, September 21st.

Donations for the Library were received from Professor Zantedeschi, of Padua; the London Meteorological, Geological, and Antiquarian Societies; the Essex Institute; the New York State Library; the Loyal Publishing Association; the Protestant Episcopal Convention of Pennsylvania; the Hon. William Duane and Reverdy Johnson; the Franklin Institute, and the College of Physicians of Philadelphia.

A donation for the Cabinet was received, through Mr. Chase, from Mr. W. K. Lanphear, of Cincinnati, consisting of 315 trade tokens.

The photograph of Professor J. C. Cresson was presented for the Album.

A communication offered for the Magellanic Premium, addressed to the President and signed "Torricelli," was read by Secretary Dr. Le Conte, and referred, as the By-Laws direct, to the Board of Officers.

The communication announces "the discovery of certain new relations between the solar and lunar diurnal variations of magnetic force, and of barometric pressure."

These relations may be expressed by the proportions:

$B' : B'' :: \sqrt{A'}\, M' : \sqrt{A''}\, M''$ (1)

$B' : M' :: A' : A''$ (2)

$B'' : M'' :: B' : B''$ (3)

A', A'', representing the tidal force of the sun and moon, respectively.

B', B'' the diurnal barometric variation.

M', M'', the diurnal magnetic variation.

Proportion (1) is readily deduced from (2) and (3).

Pending nominations Nos. 525, 526, 527, 528, were read.

The Committee upon the Purchase of a Site for the Hall, reported as follows:

"That they have received notice from Mr. Harrison that he has another applicant for the lot, and that he is now willing to sell. His price is $16,000, which may be in a reserved ground rent, re-

deemable after a few years, if the Society shall prefer, but he would prefer a few thousand dollars to be paid on account. We propose to offer $15,000; but consider that the Society should not miss the lot if satisfied with the location.

"The lot is the most central of any we know of, having the dimensions we require, with a front towards the southwest corner of Penn Square; and if this opportunity be lost, it is believed no vacant lot so suitable for our purpose can be had.

"The dimensions of the lot are 74 feet front, by 92 feet in depth, to a small street.

"We recommend that the Society make the purchase."

(Signed) ELI K. PRICE,
STEPHEN COLWELL,
F. FRALEY.

Dated October 3d, 1864.

To bring the matter before the meeting, Mr. Fraley moved that the Committee be authorized, at their discretion, to purchase the lot of Mr. Harrison, for a sum not greater than $16,000, and to make immediate payment of a portion, not exceeding $5,000.

After some discussion, on motion of Judge Sharswood, the consideration of the subject was postponed until the first stated meeting in November next.

And the Society was adjourned.

Stated Meeting, October 21, 1864.

Present, eight members.

Dr. BELL in the Chair.

A letter accepting membership was received from Dr. A. Tholuck, dated Halle, October 4th, 1864.

A letter of acknowledgment was received from the Chicago Historical Society, dated October 8th, 1864.

Donations for the Library were received from the Bureau of Public Instruction and Public Works, at Paris; the New England Loyal Publication Society; Messrs. Blanchard & Lea, and Bishop Stevens.

The death of Dr. William Pepper, a member of the Society, was announced by Dr. Coates. Dr. Pepper died on the 15th inst., aged 54. Dr. Coates was appointed to prepare an obituary notice of the deceased.

Mr. Chase made a communication on Terrestrial Magnetism as a Mechanical agent.

In a note to a former communication, I expressed my belief that the British Astronomer Royal would find in the mechanical action of the sun's rays, the precise "occasional currents" for which he was seeking, as the probable cause of magnetic storms. Mr. Airy has recently sent me a copy of his very interesting paper, (Trans. Roy. Soc., 1863, Art. XXIX.), and its perusal has greatly strengthened this belief.

All of my meteorological views rest upon the hypothesis, that the atmospheric changes, whether of humidity, temperature, pressure, electricity, or magnetism, are purely mechanical; and that being controlled by the laws of motion, their proper explanation does not require the assumption of any peculiar magnetic or electric fluid, but that a single homogeneous, elastic, and all-pervading æther, may be both the source and the receptacle of all the various forms of force. In its principal features, this theory harmonizes with the now generally accepted belief in the mechanical origin of light and heat, but in its details it involves some new and interesting special applications, which I have endeavored partially to develop.

It will be readily seen, by a reference to my communication of April 15, (*ante*, p. 367, sqq.), that the *mechanical* action of the currents to whose *electric* action Ampère ascribed the origin of terrestrial magnetism, produces two opposite spirals in the air and æther,—the lower moving from the poles to the equator, and against the earth's rotation; the upper from the equator to the poles, and in the same direction as the earth's rotation; the two being connected

by innumerable currents of convection, or threads of ascending and descending particles. It will also be evident that at every place there are two principal sets of such double spirals, one with an axis perpendicular to the earth's radius vector, producing a maximum disturbance in the early afternoon, and the other more stable and uniform, with an axis passing through the nearest poles of greatest cold. In addition to the mutual perturbations of these two principal polarizing currents, the rolling of the luni-tidal attraction-wave produces at every instant a greater or less derangement,* and I find that the ratio of the lunar-barometric to the lunar-magnetic disturbance (4.384), is nearly identical with Mr. Welsh's determination of the moment of magnetic inertia (4.4696; Phil. Trans., v. 153, p. 297). From a variety of considerations, it appears that the mechanical polarity or magnetic force thus engendered, is a third proportional to two other forces, which may be called, respectively, central and tangential.

The communication which was presented at our last meeting, in its exhibition of the first numerical relationship that has ever been pointed out between the barometric and magnetic fluctuations, showed that A : B : : B : M, a proportion in which A represents a central, B a tangential, and M a magnetic force.

I find a similar proportionality in each of Mr. Airy's summary tables (Op. citat., p. 627, sqq). Thus in his "Table II, Algebraic Sums of Magnetic Fluctuations (in terms of Horizontal Force) for each Year, from 1841 to 1857, including all Days of Record of Great Magnetical Disturbance," the Mean Disturbance is

Westerly Force.	Northerly Force.	Nadir Force.
—.00023=M.	—.00146=T.	—.00057=C.

Here the proportion T : C : : C : M gives for M a

Theoretical value,	—.000222
Observed "	—.000228
Probable error,	.000080

"Table III. Algebraic Sums of Magnetic Fluctuations (in terms of Horizontal Force) for each Year, from 1841 to 1857, including

* Besides the great disturbing agencies, whose effects may perhaps be determinable by mathematical prediction, every transient local accumulation of heat or cold will exert an influence. Everything that can produce currents or eddies in the atmosphere, may also be presumed to affect the æther, and the inconceivable rapidity of the æthereal motions, as manifested in the velocity of the waves of light and heat, will account for the extreme sensitiveness of the magnetic needle

only those Days of Great Magnetic Disturbance, in which Records were made by the three Instruments."

Theoretical value of M, ...	—.000287
Observed " "	—.000257
Probable error, ...	.000068

Tables V and VI, exhibit an approximation to the proportion, C : T : : T : M, but the approximation does not come within the limits of probable error. As no attention is paid in these two Tables to the positive and negative signs, we could not reasonably expect so satisfactory results as in Tables II and III.

"Table VIII. Sums, without regard of sign, of Coefficients of Magnetic Irregularity (in terms of Horizontal Force) for each Year, from 1841 to 1857, including all Days of Record of Great Magnetical Disturbance." The proportion C : T : : T : M, gives for M a

Theoretical value, ...	.001218
Observed "	.001203
Probable error, ...	.000066

"Table IX. Sums, without regard of sign, of Coefficients of Magnetic Irregularity (in terms of Horizontal Force) for each Year, from 1841 to 1857, including only those Days of Great Magnetic Disturbance, in which Records were made by the three Instruments."

Theoretical value of M, ...	.001137
Observed " "	.001150
Probable error, ...	.000081

In addition to these numerical coincidences, the following points in Mr. Airy's paper appear to me to be specially noteworthy.

1. "The Aggregate for the Westerly Force . . . . (taken in comparison with that for the Northerly Force), appears to show that on the whole, the direction of the Disturbing Force is 10° to the east of south;" p. 628. This indicates a line of mean disturbance about midway between the magnetic meridian (which, at London, is about N. 24° W.), and the solar meridian, or midway between the meridians of decussation in the two sets of principal spirals, to which I have referred.

2. "Sometimes two waves in one direction correspond nearly with one in the other direction. . . . . A more frequent relation appears to be, that the evanescence of one wave corresponds with the maximum of the other;" p. 635.

3. "The most striking particulars in the last line (of Tables VIII and IX) are the following:

"First, the almost exact equality of the Mean Coefficients of Irregularity in the three elements. . . . . With reference to their physical import, I think it likely that the equality of Coefficients of Irregularity may hereafter prove to be one of the most important of the facts of observation.*

"Second, the near agreement in the number of Irregularities for Westerly Force and for Northerly Force.

"Third, the near agreement in the number of Irregularities for Nadir Force with half the number of Irregularities for Westerly or for Northerly Force;" p. 641–2.

4. Tables X and XI (p. 643–4) show that the disturbances are greatest in the winter months and in the night hours. Table X, also appears to indicate minima of fluctuations and inequalities in months when there is the greatest uniformity of temperature, and maxima when the changes of temperature are greatest and most frequent.

5. Tables XI and XII furnish the materials for the following synopsis:

Forces.		Sums of Wave disturbance. +	Sums of Wave disturbance. —	Sums of Irregularities.	Mn Wave disturbances.	Average departure from Mean ±	Mean Irregularity ±	Frequency of Storms.
Westerly Force	Time of max. . . .	20 h	10 h	10 h	20 h	13 h	15 h	9 h
	Time of min. . . .	10 h	21 h	23 h	10 h	2 h	1 h	23 h
	Amt. of max. . . .	.1170	.2191	.1976	+ .00142	.00104	.00162	126
	Amt. of min. . . .	.0165	.0083	.0346	— .00165	.00056	.00074	51
Northerly Force.	Time of max. . . .	5 h	12 h	8 h	5 h	20 h	15 h	8 h
	Time of min. . . .	22 h	1 h	23 h	22 h	1–2 h	23 h	23–1 h
	Amt. of max. . . .	.1407	.2917	.1754	+ .00038	.00168	.00144	136
	Amt. of min. . . .	.0038	.0674	.0441	— .00319	.00093	.00077	57
Nadir Force.	Time of max. . . .	7 h	14 h	10 h	0 h	3 h	0 h	10 h
	Time of min. . . .	22 h	1 h	23 h	17 h	22 h	23 h	1 h
	Amt. of max. . . .	.3976	.3133	.1241	+ .00570	.00363	.00180	86
	Amt. of min. . . .	.0355	.0306	.0177	— .00380	.00157	.00074	19

"The Soli-tidal character of the principal characteristics of the occasional Magnetic Storms, as to frequency, magnitude, inequalities wave-disturbance, and Irregularities, is seen clearly in this Table." (Table XII) p. 645. There are subordinate maxima and minima, the consideration of which will become interesting, when the laws of the principals have been well ascertained and defined.

6. "In regard to the Wave-disturbance: for Westerly Force, the aggregate is + from 17 h. to 6 h., — from 7 h. to 16 h.; for Northerly

* This approach to equality appears to be still more important, in view of the proportionality—C : T : : T : M.—P. E. C.

Force, the aggregate is + from 3 h. to 5 h., — from 6 h. to 2 h.; and for Nadir Force, the aggregate is + from 23 h. to 10 h., — from 11 h. to 22 h.;" p. 644.

7. Mr. Airy presents some conclusive considerations, "showing that the observed disturbances cannot be produced by the forces of any suddenly created galvanic current or polar magnet," and remarks as follows, respecting his theory: "Its fundamental idea is, that there may be in proximity to the earth something which (to avoid unnecessary words) I shall call a Magnetic Ether; that under circumstances generally, but not always, having reference to the solar hour, and therefore, probably, depending on the sun's radiation or on its suppression, a current from N.N.W. to S.S.E., approximately, or from S.S.E. to N.N.W. (according to the boreal or austral nature of the ether), is formed in this Ether; that this current is liable to interruptions or perversions of the same kind as those which we are able to observe in currents of air and water; and that their effect is generally similar, producing eddies and whirls, of violence sometimes far exceeding that of the general current from which they are derived;" p. 646.

8. "And in the relation between E. and W. disturbances and vertical disturbances, there is a point which well deserves attention. When a water-funnel passed nearly over the observer, travelling (suppose) in a N. direction, he would first experience a strong current to the E., afterwards a strong current to the W (or *vice versa*), and between these there would be a very strong vertical pressure in one direction, not accompanied by one in the opposite direction; thus he would have half as many vertical as horizontal impulses. This state of things corresponds to the proportion which we have found throughout for the magnetic disturbances, and to the relation found in Article 18. I may also add that the rule at which we have arrived, that the waves of vertical force are few, but that their power, when they do occur, is very great, seems to correspond to what is reported of the whirlwinds of great atmospheric storms; which, violent and even frequent as they may be, occur very rarely at any assigned place;" p. 647.

I add a few considerations from Maj. Gen. Sabine's discussions. (Phil. Trans., Vol. 153, Art. XII.)

9. "The westerly deflections at Kew . . . have a decided double maximum, with an intervening interval of about eight or nine hours. . . . The conical form and single maximum which characterizes the *easterly* deflections at Kew, belong also to the easterly deflections in

all localities in North America, where the laws of the disturbances have been investigated. But . . . at Nertschinsk and Pekin . . . the conical form and single maximum characterize the *westerly* deflections, whilst the easterly have the double maximum. . . . At the two Asiatic stations, the aggregate values of the *westerly* deflections decidedly predominate, whilst in America the *easterly* deflections are no less decidedly predominant; and at Kew, . . . the amount of deflection in the two directions may be said to be balanced;" p. 282.

10. The differences of the weekly from the annual means of declination, indicate "with a very high degree of probability, an *annual variation*, whereby the north end of the magnet points more towards the east when the sun is north, and towards the west when the sun is south of the equator;" p. 291.

11. The residual errors in the monthly determinations of the Horizontal Force and of the Dip, "are thoroughly confirmatory of a semi-annual inequality, having its epochs coincident, or nearly so, with the sun's passage of the equator;" p. 303.

12. There appears to be "an increase of the Dip and of the Total Force, and a deflection of the north end of the Declination magnet towards the West, in both hemispheres, in the months from October to March, as compared with those from April to September. . . . The greater proximity of the earth to the sun in the December compared with the June Solstice most naturally presents itself as a not improbable cause; but we are as yet too little acquainted with the mode of the sun's action on the magnetism of the earth, to enter more deeply into the question at present;" p. 307.

I have neither the leisure nor the ability to undertake an exhaustive analysis of the results thus brought together; but I present them as well worthy of a profound mathematical investigation, as confirmatory in very striking and minute particulars of my mechanical hypotheses, and as furnishing new and strong presumptive evidence of that marvellous simplicity of force to which many independent branches of modern physical research so strongly point. This evidence is strengthened by the existence, as I have shown elsewhere, of the tidal law of sines in the solar-diurnal variation of the magnetic needle, by the magnetic effect of the daily barometric rotation-tide, as exhibited in the convergence of lines of equal barometric disturbance towards the hours of high barometer and their divergence from the hours of low barometer, by many points of resemblance between the daily and yearly variation-curves, both of temperature and of magnetism, and by certain considerations confirmatory of the reason-

able presumption that there may be lunar-monthly magnetic tides, somewhat analogous to those which I have pointed out in the barometer. (Proceedings of the Roy. Soc., June 16, and Am. Phil. Soc., June 17, 1864.)

Besides the differential or tidal action of the moon, there is a slight tendency to diminish the weight of the air that is nearest the moon, and to increase the weight of that which is most remote. In proportion as this tendency is exerted in conjunction with or in opposition to that of the sun, the mean solar-diurnal magnetic currents should be increased or diminished. Slight as the disturbing influence is, and modified as it must be by various causes, both occasional and periodic (*e. g.* the earth's rotation, the cyclical revolution and consequent varying latitude of the moon at the commencement of each new month, the oscillations in the aerial rotation-spheroid produced by lunar attraction, the changes in the average temperature of day

TABLE I.

*Solar and Lunar Daily Magnetic Tides, in parts of Force.**

Solar and Lunar Hours.	Horizontal Force.		Vertical Force.		Total Force.	
	Solar.	Lunar.	Solar.	Lunar.	Solar.	Lunar.
	.00	.000	.000	.000	.000	.000
0	+1099	+006	—022	—005	+95	+005
1	+0911	—003	+229	+027	+82	—001
2	+0623	—011	+446	+031	+60	—005
3	+0368	—014	+593	+044	+40	—006
4	+0133	—020	+638	+072	+20	—007
5	—0080	—014	+608	+041	+01	—006
6	—0270	—007	+611	+050	—15	+001
7	—0394	—004	+545	+028	—26	+001
8	—0465	000	+300	—012	—36	—002
9	—0511	+022	+219	—011	—41	+018
10	—0530	+032	+074	—017	—45	+025
11	—0522	+031	—011	—037	—45	+022
12	—0481	+019	—100	—003	—43	+016
13	—0449	+017	—165	+005	—41	+015
14	—0405	+013	—224	+019	—38	+014
15	—0376	—009	—289	+048	—36	—001
16	—0352	—011	—345	+051	—35	—002
17	—0329	—008	—398	+029	—34	—003
18	—0298	—009	—465	+013	—32	—006
19	—0154	—004	—513	—011	—20	—005
20	+0130	+003	—582	—053	+03	—005
21	+0470	+006	—491	—050	+34	—002
22	+0803	+013	—427	—054	+63	+004
23	+1019	+009	—214	—067	+85	—001

* The first decimal figures are placed, for convenience, in an upper line.

and night at different seasons and in different years, &c.), it may yet, perhaps, be discernible in comparing the results of a long series of careful and delicate observations. The accompanying tables are deduced from such a comparison of the St. Helena records.

Table I is compiled from Maj. Gen. Sabine's Tables 36, 37, 50, 51, 52, 53 (St. Helena Observations, Vol. II). It is specially interesting as showing the influence of the opposition of attraction to rotation in producing low solar tides at 10 or 11 P. M., the prompt and direct influence of the sun upon the æthereal currents in the production of a high tide at noon, the double maxima and minima in each of the lunar tides, the additional confirmation of the analogies that I have heretofore pointed out between the spheroids of attraction and rotation, the opposition of the solar and the resemblance of

TABLE II.

Lunar-Monthly Magnetic Tide of Horizontal Force.

Moon's Position. °	Mean Daily Fluctuations of Horizontal Force at St. Helena.*			
	1844.	1845.	1846.	1844–6. Average.
0	61.31	53.75	40.88	51.98
15	61.66	53.29	41.24	52.06
30	62 20	52.85	41.73	52.26
45	62.32	53.61	41.81	52.58
60	62.56	52.40	40.66	51.87
75	62 76	52 36	41.34	52.15
90	61.82	52.80	41.54	52.05
105	61.37	53.11	40.42	51.63
120	60.47	53.43	39.97	51.29
135	59.42	53.60	40.46	51.16
150	60 23	53.01	40 14	51.13
165	60.54	53.46	39.72	51.24
180	58.81	53.91	40.86	51.19
195	59.39	53.64	40.27	51.10
210	59.35	53.57	40.70	51.20
225	58.88	52.91	40.74	50.85
240	59.66	52 80	39.79	50.75
255	60.35	52.92	40.70	51.32
270	60.50	53.43	40.65	51.51
285	60.89	53 81	41.10	51.94
300	61.64	52.82	41.41	51.96
315	61.80	53.10	41.34	52 08
330	62.14	53.45	42 39	52.66
345	62.16	52.97	41.85	52.32

* The value of one scale division is .00019 of the Horizontal Force, in 1844 and 1845, and .00021 in 1846.

the lunar zenith and nadir effects, and the evidence in the partial "establishment" of the moon's tides that most of her magnetic influence is exerted indirectly on the æther, through the intervention of atmospheric attraction-currents.

Tables II and III were formed by taking the mean of the hourly averages, on the twenty-four days in each lunar month which are most nearly indicated by the angular positions given in the first column. Each of the tabular numbers for 1844 and 1845 represents the average of two hundred and eighty-eight hourly observations; each of the numbers for 1846, the average of two hundred and sixty-four observations, with a few exceptions of holidays and other omitted days, for which the missing numbers were interpolated. Table II indicates a tendency to mean lunar influence between 90° and

TABLE III.

Lunar-Monthly Magnetic Tide of Vertical Force.

Moon's Position. °	Mean Daily Fluctuations of Vertical Force at St. Helena.*			
	1844.	1845.	1846.	1844–6. Average.
0	48.42	48.51	43 56	46.83
15	48.21	48 55	43.90	46.89
30	47.33	48.53	44.55	46.80
45	47 33	48 25	43 96	46 51
60	47.45	48.47	43.69	46.54
75	47.62	47.88	44.22	46.57
90	47.65	47.43	44.77	46.62
105	47.62	46.92	45.31	46.62
120	47.53	47.42	45.65	46.87
135	47.76	47.40	47.30	47.49
150	47.55	47.50	47.23	47.43
165	47.52	47.70	47.02	47.41
180	47 06	47.77	46.54	47.12
195	47.96	48.02	46.29	47.42
210	48.14	48.26	45 88	47.43
225	47.49	48.26	46.39	47 38
240	48.40	48.60	45.32	47.44
255	48.16	48.52	44.64	47.11
270	48.00	48 08	44.54	46.87
285	47.93	47.70	44.61	46.75
300	48.06	48.26	44.91	47.08
315	48.17	48.56	44.95	47.23
330	48.49	47.91	43.78	46.73
345	48.18	47.44	43.99	46.54

* The value of one scale division varies from .00051 to .00091 of the Vertical Force.

105°, and between 270° and 285°, the influence increasing when the moon acts either in conjunction with the sun, or directly upon condensed air and *vice versâ*. It also shows the existence of disturbances, which may be accounted for by some of the causes to which I have already referred. Table III exhibits apparent tendencies to diminution of force near the syzygies, and to increase of force a day or two after the quadratures.

Table IV is a compendium of the tidal differences in the two preceding tables. It shows the effect of temperature in producing maxima and minima when the coolest and warmest portions of the earth are submitted to the direct action of the moon (at or near 240° and 45°), low temperature producing a minimum of horizontal force, with a maximum of vertical force, and *vice versâ*. From the variations of horizontal force $\left(\frac{\Delta X}{X}\right)$ and vertical force $\left(\frac{\Delta Y}{Y}\right)$ given in this table, Table V is formed, the mean variations of total force $\left(\frac{\Delta \varphi}{\varphi}\right)$ being

TABLE IV.

Lunar-Monthly Magnetic Tide. Differences from Monthly Means.

Moon's Position. °	Horizontal Force.			Vertical Force.			Means	
	1844.	1845.	1846.	1844.	1845.	1846.	H. F.	V. F.
0	+ .38	+.54	— .02	+.59	+ .51	—1.56	+.30	—.16
15	+ .73	+.08	+ .34	+.38	+ .55	—1.22	+.38	—.10
30	+1.27	—.36	+ .83	—.50	+ .53	— .57	+.58	—.19
45	+1 39	+.40	+ .91	—.50	+ 25	—1.16	+.90	—.48
60	+1 63	—81	— .24	—.38	+ .47	—1.43	+.19	—.45
75	+1.83	—.85	+ .44	—.21	— .12	— .90	+.47	—.42
90	+ .89	—.41	+ .64	—.18	— 57	— .35	+.37	—.37
105	+ .44	—.10	— .48	—.21	—1.08	+ .19	—.05	—.37
120	— .46	+.22	— .93	—30	— .58	+ .53	—.39	—.12
135	—1 51	+.39	— .44	—07	— .60	+2 18	—.52	+.50
150	— .70	—.20	— .76	—.28	— .50	+2.11	—55	+44
165	— .39	+.25	—1.18	—.31	— .30	+1.90	—.44	+.42
180	—2.12	+.70	— .04	—.77	— .23	+1 42	—.49	+.13
195	—1.54	+.43	— .63	+.13	+ .02	+1.17	—.58	+.43
210	—1.58	+.36	— .20	+.31	+ .26	+ .76	—.48	+.44
225	—2.05	—.30	— .16	—.34	+ .26	+1.27	—.83	+.39
240	—1.27	—.41	—1.11	+.57	+ .60	+ .20	—.93	+.45
255	— .58	—.29	— .20	+.33	+ .52	— .48	—.36	+.12
270	— .43	+.22	— .25	+.17	+ .08	— 58	—.17	—.12
285	— .04	+60	+ .20	+.10	— .30	— .51	+.26	—.24
300	+ .71	—.39	+ .51	+23	+ .26	— .21	+.28	+09
315	+ .87	—.11	+ .44	+.34	+ .56	— .17	+.40	+24
330	+1.21	+.24	+1 49	+.66	— .09	—1.34	+.98	—.26
345	+1.23	—.24	+ .95	+.35	— .56	—1.13	+.64	—.45

obtained by the formula $\frac{\triangle\varphi}{\varphi} = \cos^2\theta\,\frac{\triangle X}{X} + \sin^2\theta\,\frac{\triangle Y}{Y}$. I have taken $\theta = -22°$; one scale division of horizontal force $= .000194$; one division of vertical force $= .000792$; which are almost identical with the values employed by Gen. Sabine in the computation of his Tables of hourly variation in solar and lunar total force.

In a similar manner I have computed Table VI, showing the average hourly variations, both in solar and lunar total force, in each of the three years which have furnished the data for most of my deductions. The first decimal figures are placed in an upper line, as in Table I. Perhaps the principal utility of this table may be found in some future extension of these investigations, but even now it is interesting, inasmuch as it exhibits the probable influence of periodic causes in shifting the hours of the daily maxima and minima, and as it lends, added weight to the preceding tables, by showing that the monthly tide is more regular than the daily tide.

TABLE V.

Lunar-Monthly Magnetic Tide of Total Force.

Moon's Position.	Mean Daily Fluctuations at St. Helena, in parts of Total Force.			
°	1844.	1845.	1846.	1844-46. Average.
0	+.00013	+.00015	—.00018	+.00003
15	+.00017	+.00007	—.00008	+ 00005
30	+.00016	.00000	+.00007	+.00008
45	+.00018	+.00009	+.00002	+ 00010
60	+.00023	—.00008	—.00020	—.00002
75	+.00028	— 00015	— 00003	+ 00003
90	+.00013	—.00013	+.00007	+ 00002
105	+.00005	—.00014	—.00006	—.00005
120	—.00011	—.00003	—.00010	—.00008
135	—.00026	.00000	+.00017	—.00003
150	—.00015	—.00009	+.00011	—.00004
165	—.00010	+.00001	+.00001	—.00003
180	—.00044	+.00009	+.00015	—.00007
195	—.00024	+.00007	+.00003	—.00005
210	—.00023	+.00009	+.00005	— 00003
225	—.00038	—.00002	+.00012	—.00009
240	—.00015	.00000	—.00016	—.00010
255	—.00006	+.00001	—.00009	— 00005
270	— 00005	+.00005	—.00011	— 00004
285	.00000	+.00007	—.00002	+.00002
300	+.00014	— 00004	+ 00006	+ 00006
315	+.00018	+.00004	+.00005	+.00009
330	+.00027	+.00003	+.00010	+.00013
345	+.00024	—.00010	+ 00003	+ 00006

It seems not improbable that the mutual planetary perturbations which are sufficiently powerful to affect their orbital revolution, may also exert an appreciable influence on their æthereal spheroids, and that numerous cyclical magnetic variations may be thus produced. The disturbance of Jupiter is by far more important than that of any other planet, its mean attractive energy being nearly a third proportional to those of the sun and moon.* The annual fluctuations are very great, the intensity being about $\frac{1}{114}$ when Jupiter is nearest the earth, and less than half as great, or only about $\frac{1}{247}$, when most remote. The combined operation of the tropical revolutions of Jupiter, the moon's apsides, and the moon's nodes, should produce a series of disturbances corresponding very nearly in duration with

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TABLE VI.

Solar and Lunar-Daily Tides of Total Force.

Solar and Lunar Hours	1844.		1845.		1846.	
	Solar.	Lunar.	Solar.	Lunar.	Solar.	Lunar.
	.000.	.000.	.000.	.000.	.00.	.000.
0	+83	+009	+88	—009	+·066	+004
1	+83	+011	+97	—014	+104	+015
2	+67	—005	+85	—016	+097	—004
3	+49	—004	+63	—008	+076	+018
4	+28	—024	+41	—012	+054	+017
5	+15	—032	+20	—001	+031	+024
6	+02	—027	+02	+002	+008	+028
7	—11	—016	—11	+010	—014	+022
8	—22	—006	—24	+003	—026	+022
9	—31	+001	—35	+034	—036	+022
10	—35	+008	—39	+041	—043	+024
11	—37	+029	—46	+031	—047	+021
12	—37	+017	—48	+021	—053	+008
13	—38	+021	—43	+012	—048	+011
14	—39	+045	—44	+012	—010	—001
15	—32	+021	—42	+006	—038	—029
16	—30	+061	—39	+006	—043	—033
17	—29	—004	—39	+006	—041	—027
18	—22	—012	—37	—008	—042	—020
19	—24	—006	—36	—016	—041	—019
20	—16	—014	—24	—008	—027	—011
21	+07	+017	+03	—006	—008	—021
22	+38	+022	+32	—002	+029	—008
23	+64	+016	+63	—008	+063	—010

* If we take as our unit the moon's attraction for the earth $\frac{M}{D^2}$, he sun's will be about 177, and Jupiter's $\frac{1}{174}$.

Gen. Sabine's magnetic "decennial period," and Schwabe's period of solar spots.

The law of varying attraction suggests a plausible explanation for the approximate mean proportionality of the barometric to the tidal and magnetic variations. For the ratios of attraction of any planet when in solar conjunction, at quadrature, and in opposition, vary as $(n+1)^2$, n^2, and $(n-1)^2$, respectively, the attraction at the mean distance being nearly a mean proportional between the maximum and minimum attractions. The barometrical fluctuations are occasioned by variations in the gravitation of the air towards the earth's centre,—the tidal motions, by the influence of distant heavenly bodies,—and the magnetic, according to my hypothesis, by the oscillations of the air and æther in their efforts to restore the unsettled equilibrium. The three disturbances, therefore, must evidently have nearly the same mutual relations as if they were produced by three forces, one centripetal, and the other two centrifugal, the two latter being nearly equal in amount but diametrically opposed in direction. This leads us at once, theoretically, to the general formula with which we started empirically,

$$A : B :: B : M,$$

and strengthens the conviction that there are none of the phenomena of terrestrial magnetism which cannot be explained, either by the instantaneously received and instantaneously transmitted impressions which are made directly upon the æther by attraction, heat, or rotation,—by the more sluggish oscillations of the air, which originate from the same sources,—or by the combination of the two.

Every particle is exposed to the influence of these several impressions, the tidal waves of the solid earth having a range, according to Prof. Thomson's calculations (Phil. Trans., Vol. 153, p. 574), at least two-fifths as great as if the globe were entirely fluid. There is, therefore, good reason to hope, that by the application of mechanical laws to the several phases of the æthereal undulations which produce the phenomena of light, heat, electricity, polarity, aggregation, and diffusion, we may obtain a clearer understanding, not only of all the meteorological changes, but also of seismic tremors, crystallization,* stratification, chemical action, and general morphology.

* The phosphorescence that is often observed during the process of crystallization, and the auroral displays in frosty air, are perhaps owing to analogous vibrations. Every chemical, as well as every physical action produces a ponderable disturbance of equilibrium, which must give rise to æthereal oscillations, to which, in their simplest form, we give the name of electric, magnetic, or galvanic currents.

If density is a functional product of superficial magnetism and central attraction, the resemblance of the formula $B = \sqrt{AM}$, to the expression of Mr. Graham's experimental law of molecular diffusion, Time $= F \sqrt{\text{Density}}$ (Proc. Roy. Soc. No. 56, p. 616–7), and to the general theoretical formula of which Mr. Graham's is a corollary,

$$\text{Velocity} = F \sqrt{\frac{\text{Elasticity}}{\text{Density.}}}$$

may be something more than accidental.

If we assume the atmospheric density as our unit, $D' = 1$, and represent the aerial and ætherial elasticities by E', E'', respectively, the proportion

$$\tfrac{1}{5} : 192{,}000 :: \sqrt{\frac{E'}{D'}} : \sqrt{\frac{E''}{D''}}$$

gives an approximate value for the density of the kinetic æther, $D'' = .00000000000108 \frac{E''}{E'}$. The magnetic and barometric fluctuations may perhaps furnish the necessary data for determining the unknown ratio $\frac{E''}{E'}$.

Mr. Marsh exhibited a Manuscript Chart, and read a letter from Mr. R. P. Gregg, of Manchester, England, in reference to the recent observations of Messrs. Gregg and Herschel, upon the radiant points of Star Showers.

Pending nominations Nos. 525, 526, 527, 528, were read and balloted for.

On motion of the Librarian, with the approval of the Committee on the Library, the sum of seventy dollars and ten cents ($70 10), was appropriated to pay Messrs. Pawson and Nicholson's bill of 14th inst., for the binding of books.

There being no other business, the ballot boxes were examined by the presiding officer, and the following persons were declared duly elected members of the Society:

Rev. Prof. T. C. Porter, of Lancaster, Pa.
Rev. John Bost, of Laforce, near Bergerac, France.
Rev. Prof. C. P. Krauth, of Philadelphia.
Mr. R. H. Lamborn, of Altoona, Blair County, Pa.

And the Society was adjourned.

Stated Meeting, November 4, 1864.

Present, twenty-two members.

Professor CRESSON, Vice-President, in the Chair.

Letters accepting membership were received from Prof. Tunner, dated Leoben, October 6th, and Dr. Schinz, dated Strasburg, October 9th, 1864.

Letters of acknowledgment were received from the Geological Institute, dated Vienna, September 19th, 1862; the Royal Society, dated London, May 16th; and the Linnean Society, dated August 8th, 1864.

Letters of envoi were received from the Imperial Academy, dated Vienna, June 23d; the Royal Academy, dated Berlin, February 29th; and the Royal Academy, dated Madrid, April 20th, 1864.

Photographs for the Album were received from Mr. Peter W. Sheafer, Prof. Tunner, and Dr. Schinz.

Donations for the Library were received from the Societies and Academies at Königsberg, Berlin, Vienna, St. Gallen, Frankfort on Maine, Bonn, Haarlem, and Madrid; the Institut de France; the Royal, Royal Geographical, Chemical, Zoological, and Linnean Societies, at London; the Royal Dublin Society; Mr. Safford, of Cambridge; Mr. Whitmore, of Salem; Rev. E. C. Jones, of Blockley; Mr. Evans, of Philadelphia, and the Franklin Institute.

The death of Admiral Sir John Washington, a member of this Society, at Havre, in the sixty-third year of his age, was announced by the Secretary, who read an Obituary Notice of the deceased from the last anniversary address of the President of the Royal Geographical Society.

The Secretary presented a communication intended for the Transactions, by Prof. Jacob Ennis, entitled "The Nebular

Hypothesis;" it was referred to a committee, consisting of Prof. Kendall, Mr. Chase, and Mr. Marsh.

The stated business being called for, the report of the Special Committee on the Purchase of a Site for a new Hall was read from the minutes of October 7th. Mr. Fraley was requested to make a statement of the financial condition of the Society, which he did, and after debate by the members, the resolution of October 7th was again read, and, on the question being put to the meeting, it was not adopted.

On motion of Mr. Fraley, and at the suggestion of the Treasurer, the sum of one hundred and fifty dollars additional, was appropriated to the general account of the current year.

And the Society was adjourned.

Stated Meeting, November 18, 1864.

Present, twelve members.

Dr. Wood, President, in the Chair.

Letters accepting membership were read, from Prof. T. C. Porter, dated Lancaster, November 11th, and from Prof. Bernard Studer, dated Berne, October 30th, 1864.

Donations for the Library were received from the British Association for the Advancement of Science; the Royal Astronomical Society; Prof. Treadwell, of Cambridge, Mass.; Silliman's Journal; Dr. Tafel, and Blanchard & Lea, of Philadelphia.

Dr. Goodwin read an obituary notice of Dr. Hitchcock.

OBITUARY NOTICE OF THE REV. PROF. EDWARD HITCHCOCK, D.D., LL.D.

This distinguished member of the American Philosophical Society died near the close of last February. The following leading facts of his life, presented as dry chronological data, together with a general estimate of his character and labors, are chiefly drawn from a funeral discourse by Professor Tyler.

"Dr. Hitchcock was born at Deerfield, Massachusetts, in 1793; was principal of the academy in his native place from 1815 to 1818; entered the Congregational ministry in 1821, and continued the pastor of a church until 1825, when he was elected Professor of Chemistry and Natural History in Amherst College; he was appointed State Geologist of Massachusetts in 1830, and of the first district of New York in 1836; was chosen President of Amherst College and Professor of Natural Theology and Geology in 1844; was appointed Commissioner of Massachusetts, to examine the Agricultural Schools of Europe in 1850; retired from the Presidency of Amherst College in 1854; was appointed to complete the Geological Survey of Vermont in 1857; and continued to lecture in his Professorship of Natural Theology and Geology till the time of his death."

Besides his membership in our Society, "his elections to membership in literary and scientific associations in his own country and in foreign lands, and his invitations to other fields and departments of labor which he did not feel at liberty to accept, were too numerous to be mentioned."

"It is curious enough, that his first publication was a poem of five hundred lines, which appeared in 1815, on 'The Downfall of Bonaparte.' It drew attention to the youthful author, and also procured him some substantial benefits. His next appearance before the public was in quite another capacity, that of a mathematician and astronomer. The American republisher of the English Nautical Almanac offered ten dollars to any man who should discover an error. The young savant of Deerfield, then Principal of Deerfield Academy, sent him a list of forty-seven errors, and, on receiving only evasive answers, published the list. This drew forth a contemptuous reply, in which the critic who has presumed to arraign the editor of the Nautical Almanac, is spoken of as 'one Edward Hitchcock.' The calculations for the next year were revised with great care, but no sooner had the almanac appeared than that same Edward Hitchcock

dared to send out after it a list of errors more numerous than that of the previous year. And so the controversy went on, till the editor, discovering his mistake, changed his tone, and one Edward Hitchcock became first Mr. Edward Hitchcock, and at length due acknowledgment was made in the preface, of the editor's obligations to 'Edward Hitchcock, Esq., to whom much credit is due for the industry and talent bestowed on the work.' During the four years of his connection with Deerfield Academy, he went through every year all the calculations for the Farmer's Almanac, not excepting those for the weather, to which his imagination was as competent as his science was to calculate the eclipses and conjunctions."

"While in charge of his parish at Conway, he found exercise and recreation in making a scientific survey of the western counties of Massachusetts. This was the beginning of that life among the rocks and mountains, which was ever after a delight and almost a passion. Like the giant in classical mythology, whenever he could plant his feet on the bosom of his mother earth, he was in his element; it was his strength, his health, his life. This was also the origin of the geological survey of the entire State, which was afterwards made by the Government at his suggestion, and which has the honor of originating that rapid succession of scientific surveys in the sever[al] States, which has since done so much to develop the mineral a[nd] agricultural resources of our country."

"Thus the way was prepared for his appointment as the first Pr[o]fessor in the chair of Chemistry and Natural History in Amhe[rst] College. When he entered upon the duties of his office, the Coll[ege] was yet in its infancy. The chemical apparatus was then not wo[rth] ten dollars. Cabinet there was none. Not even a beginning [had] been made of those magnificent scientific collections which now ad[orn] the College halls. For many years he was sole professor in all departments of Natural History. He lectured and instructe[d in] Chemistry, Botany, Mineralogy, Geology, Zoology, Anatomy Physiology, Natural Theology, and sometimes—to fill a temp[orary] vacancy—he was the most suitable person the College could d[o] to teach also Natural Philosophy and Astronomy. Like Solom[on he] spake of trees, from the cedar tree that is in Lebanon to the [hyssop] that groweth out of the wall; he spake also of beasts, and o[f fowl], and of creeping things, and of fishes. He spake also of rock[s and] soils, of which, so far as appears, Solomon did *not* speak. H[e spake] also in songs and proverbs, to say nothing of playing the Eccl[esiast] in making sermons. He lived to see the departments of his o[...]

professorship occupy, in whole or in part, the time of four men; the chemical laboratory and apparatus among the finest in the United States, and the scientific collections filling two spacious edifices; and all this the fruit, directly or indirectly, of his own enterprise, energy, and perseverance. Dr. Hitchcock created the *material* and the reputation of Amherst College in the Department of Natural History."

"He had the originality and creative power which belong to genius. He was made for a discoverer, for an originator of new ideas, new theories, new methods, new measures. He was tall enough to see over the heads of those around him, and catch the first dawning beams of a new day. He had more faith than most men in new discoveries. This believing disposition sometimes amounted to credulity, and welcomed a premature announcement, or a fabrication even, like the celebrated moon hoax; but it expected great things, attempted great things, and achieved great things, for science. It wrought miracles in the scientific world. He saw an element of truth in Phrenology, recognized some unknown and mysterious power in Animal Magnetism, or Mesmerism, as he more frequently called it; and in the true spirit of a philosopher, sought to extricate the truth and discover the power. As a Christian philosopher he welcomed every discovery in Geology and the physical sciences, never doubting that they would not only harmonize with, but illustrate and confirm, the Sacred Scriptures. Ichnology, as a science, began, and as yet may almost be said to end, with him. He was the originator of the State Scientific Surveys. The American Scientific Association is said to have sprung from his suggestion; and he was its first President. He possessed in a remarkable degree that power of rapid and wide generalization, by which the fall of an apple suggested to Newton the law of universal gravitation. Taught by a few terraces on the hillsides, he could reconstruct the Connecticut Valley at each successive geological epoch of its existence; and guided by a few footmarks in the sandstone, he could repeople it with its various orders and tribes of primeval inhabitants. If he had not been a great geologist and naturalist, he would have been a great astronomer and mathematician. The question which he should be, turned, not on the faculties with which he was endowed, but on the accident, or rather the providence, of his impaired health and eyesight."

"In addition to the engrossing labors of a professorship combining several distinct departments, or of the presidency, combined with a professorship quite sufficient of itself to employ one man, and besides

the innumerable special plans and efforts to raise funds, build cabinets, and make scientific collections, he has published to the world more than twenty books, of all sizes, from small duodecimos to large quartos, besides innumerable articles in the daily, weekly, and quarterly literary, scientific, or theological journals, amounting in all to eight thousand pages. Several of these books, besides numerous editions in this country, have been republished in Europe, and won for him a world-wide reputation."—(Thus far chiefly in the words of Prof. Tyler.)

But after all, Dr. Hitchcock was not so much a great genius, or a great savant, as a great and good man.

There are two characteristic and salient traits in his scientific history, to which it may not be amiss to draw special attention. The first is, that, like Newton, he always held science and religion together, not in antagonism, but in co-ordination and harmony. The second is, that, like Franklin, he combined his scientific pursuits with a steady and zealous devotion to the duties and utilities of practical life.

However engrossed by his favorite geological studies, he was still a Christian believer; and there was no subject of investigation of greater interest with him than to trace out the harmony between faith and reason, between nature and revelation, between the discoveries of science and the disclosures of the Bible. In this he differed from many scientific men of the present time; and thus, perhaps, he even lost caste in the view of some, and came to be regarded as weak or narrow-minded, or deficient in scientific force and freedom. Had he ignored or even assailed the Bible, his scientific reputation, his character as an independent thinker, inquirer, and discoverer, might perhaps have stood higher than they now do. Besides those who think that modern discoveries and the "positive philosophy," have at length demolished the Bible, there are many more who think that, at least, science has nothing at all to do with the Bible, either for it or against it.

Here we find two extreme parties. On the one hand, too many religious men and religious teachers are in the habit of denying and anathematizing science, or treating it with vituperation and scorn, as if it were the natural enemy of Christianity, the fountain of error and infidelity, of impiety and atheism. And on the other hand, scientific men have by no means been wanting, who have been ready, on every occasion, to make a thrust at the Christian Scriptures, showing up their alleged blunders and scientific ineptitudes; or, ignoring their

existence altogether, coolly to take their falsehood for granted, and pass by their testimony in silence, while propounding theories and doctrines in palpable antagonism with their received and accredited teaching.

With neither of these parties did Dr. Hitchcock have any sympathies; and in this he showed the truest scientific as well as religious instinct. For not only is anti-scientific bigotry suicidal for the religious teacher, but anti-christian bigotry is equally so for the scientific inquirer.

Is it true that Science is simply to mind her own business and let the Bible take care of itself? This is, perhaps, the prevailing tone of the scientific world. But is such a view philosophical? Is such a position tenable—*scientifically* tenable? So far as Science restricts herself to the discovery, the orderly digesting, and historical statement of *facts*, it is all well. She need not trouble herself about the Bible; just as she need not trouble herself about ethics or mathematics. But the moment she proceeds to enunciate a theory, to draw inferences from her facts, to dogmatize, she is not at liberty coolly to announce as verities or even as probabilities, doctrines which stand in flagrant contradiction to other facts and other truths resting upon appropriate and commonly received evidence,—and that, too, without attempting to refute, or even so much as alluding to, those other alleged facts and truths, or to the evidence on which they repose. Such a procedure cannot claim to be either philosophical or scientific. Science must aim at a harmony of truth, at a unity of conception. No truth, no evidence lies beyond her sphere. If she reject any facts, if she neglect any testimony, she undermines the very foundations of her whole edifice. It is not narrow-mindedness but large-mindedness, which leads a true philosopher to take into his account all the facts and all the evidence from all sources and of every kind, before drawing his definitive conclusion.

It seems to be too often forgotten that there is *real evidence* for the truth of the Christian religion, and for the Divine authority of the Holy Scriptures, and consequently for the truth of whatever they teach,—evidence of facts and testimony,—evidence, taken as a whole, of vastly greater compass and weight than there is for any scientific dogma whatever, which stands in contradiction to the Bible or any of its contents,—evidence which cannot be annihilated or rebutted by being simply ignored,—evidence which, until it is fairly and directly met and refuted, stands firm, and will stand firm forever.—(*Vid.* Rev. of Lyell's Antiquity of Man, in the Am. Theol. and Presb. Quart. Rev., April, 1864.)

Dr. Hitchcock did not pursue his studies as a man of scientific leisure. He did more than one man's work as a Professor and College President. He was the head and heart and soul of Amherst College,—its real father and founder. He made it and left it what it is. Nor did the College absorb all his practical energies. He took a deep interest and an active part in the cause of popular education, and particularly of female education. Sympathy for the masses conspired with his zeal for the promotion of Christian culture to interest him deeply in all the early plans and efforts for the establishment of the celebrated Mount Holyoke Seminary. "All the principles and methods in which it should be founded and conducted were discussed with him and other friends of learning and religion at his house; and when, at length, they were sufficiently matured, his tongue and his pen were among the chief organs for communicating them to the public. And from that time to the day of his death, next to Amherst College, Mount Holyoke Seminary was the child of his affections and the object of his constant watch and care."

In active efforts also for the suppression of intemperance, he took a zealous and prominent share. And, whatever may be thought of the special plans or processes of some of the friends of the so-called Temperance movement, surely no one can witness the multiform evils and mighty woes brought upon the community by the intemperate use of intoxicating drinks, and wonder that a man of moral principle and Christian character, of humane instincts and almost feminine sensibility, should have had his spirit stirred within him to seek some remedy, to put forth some effort, for the removal of such a prolific source of evil, for the eradication of such a loathsome and deadly cancer from the bosom of society.

Amidst all his studies and avocations, Dr. Hitchcock never forgot his relation to the Church of Christ and his character as a Christian minister. He was punctual, diligent and zealous in the discharge of every religious duty.

Nor did he forget his obligations to his country. He was a stern patriot, a loyal man, and a good citizen.

He was a Christian; but his type of a Christian was not a monk; he was religious, but not what the French call *un religieux;* he was devout, but not a *dévôt.*

He was a Christain minister; but his ideal of a Christian minister was neither the mere functional priest, nor the mere professional preacher, nor both combined. In becoming a Christian and a clergyman he had not ceased to be a man, and to be interested in whatever

is addressed to human intelligence and human sympathy by the God of Nature and of Providence, and by the actual condition, the wants and the welfare, and the manifold activities and relations of mankind.

He was a scientific man, but not that alone. In recognizing the relations of his intellect to nature, he did not allow himself to become so absorbed in them as to forget the higher relations of mind and heart to God, and the broader and the closer relations of both to society.

In the imminent danger of his country, he was no mere ingenious Archimedes. He never would have met an irruption of hostile and triumphant soldiery into his house with a "*nolite turbare circulos meos.*" He was no literary recluse. He had no affinity of character with such a man as Joseph Scaliger. He could not have been so engrossed in the study of Homer as not to have been aware of such a scene as the massacre of St. Bartholomew's eve, or of his own hair-breadth escape from the common butchery, until the day subsequent to the catastrophe.

He observed, he studied, he thought, he felt, he acted; but he was no mere observer, no mere student, no mere thinker, no mere sentimentalist, no mere agitator or drudge, no mere fragment of humanity, however sharp, or polished, or brilliant. He was a whole-souled, large-minded, living man, recognizing his practical relations to man and God, as well as his intellectual relations to nature and truth. His highest ambition and most fervent prayer undoubtedly were, to be a true man and an earnest Christian, rather than a *savan* or a philosopher, to have his name written among the wise who shall shine as the brightness of the firmament, rather than emblazoned on the records of human science and learning. To him, as to Solomon, God gave more than he asked.

PHILADELPHIA, November 18, 1864.

The death of Dr. Heinrich Rose was announced by the Secretary, as having taken place at Berlin on the 27th of January last, at the age of sixty-eight years and five months.

The minutes of the last Stated Meeting of the Board of Officers and Council were read.

And the Society was adjourned.

Dr. Harris exhibited specimens of *Crude Borax* or *Tincal*, and *Refined Borax*, obtained from the lake country of California, about 130 miles north of San Francisco, where it is deposited in the form of small crystals, and large crystalline masses, varying from a few grains to half a pound in weight, at the bottom of several small lakes, the waters of which are saturated with this salt. The most important of these lakes is situated in the vicinity of "Clear Lake," and covers about 200 acres of land.

The existence of this mineral in California has been known for several years, but the greater inducements offered by gold mining, have occasioned it to be neglected until recently, when a Company was formed for the purpose of collecting and refining it. This corporation owns about 2200 acres of land, embracing the borax lakes, a boiling spring of boracic acid, and an immense deposit of sulphur, of a remarkable degree of purity.

The crude borax of California is remarkably fine, being crystallized in hexagonal prisms, of a slightly greenish hue, translucent, and efflorescing slowly. It is entirely free from any soapy or greasy feel, which is common to the crude borax of India, and is said to contain but about ten per cent. of impurities. The "refined borax," is not entirely pure, and not being prepared as it should be, contains too large a proportion of water of crystallization, the loss of which causes a considerable efflorescence to appear on the surface.

The Company raise the crude borax with a dredging machine, wash it free from mud, and then refine it. They intend, also, to evaporate the water of crystallization by artificial heat, and to combine the boracic acid of the boiling springs with soda. They have not as yet completed their arrangements, and have therefore prepared thus far comparatively little for the Eastern market.

Hitherto, we have been supplied with borax from Thibet and Persia, by the way of Calcutta; from Tuscany; and on this continent, from Peru and Ecuador. That from Thibet and Persia is obtained from lakes; that of Tuscany is produced artificially, from boracic acid springs, by reaction between the acid solution and carbonate of soda. South American borax is obtained by the purification of a mineral consisting in large measure of borate of soda and borate of lime. In a short time we shall, no doubt, be chiefly supplied from California.

Mr. Peale communicated a record of a portion of 134 soundings, taken by himself, along the Delaware River, at the Water Gap.

DELAWARE WATER GAP.

Record of the depth of water in the Delaware, as ascertained by 134 soundings, begun at the boat-landing, near the old Saw-mill above the Gap, and continued below the Gap, a distance of about 1½ miles, on the 4th day of October, 1859; the river being at the average low water mark.

	Feet.	Inches.
Stern of the batteau, ...	3	4
At intervals, to the Bar, ...	4	
	4	6
	4	9
	4	6
	4	
	3	9
	3	
	2	9
	3	
	2	9
On the Bar, ...	2	3
	3	
	6	
	8	6
Middle Channel, ...	10	
	8	
Opposite small house on the Jersey shore, . .	9	
	8	9
	10	6
	11	
	12	
Opposite Lover's Leap, ...	13	
	12	9
	13	
Rebecca's Well, ...	15	6
	14	
	13	6
Old house on Pennsylvania side, ...	14	3

	Feet.	Inches.
Prospect Rock, ...	15	
	16	6
	17	6
	18	
Poplars on Jersey shore, ...	19	
	21	
	22	9
Above Point of Rocks, ...	23	
Sandy Bottom;	26	
	28	
Rocky Bottom, which runs from the shore, reducing the depth, as follows, ...	31	6
	24	
	20	
Thirty or forty feet further east, . . .	27	
Point of Rocks, ...	25	
	26	
	23	
Sandy Bottom,	20	
Indian Mound, Stony Bottom, ...	18	
Creek Mouth from Dunfield's Hollow, . .	22	
	21	
Sandy Bottom,	22	
Slate Factory, ...	21	9
	19	3
	20	
Pennsylvania Mountain, ...	21	
	19	6
	18	
	17	6
	16	6
Between Pennsylvania and Jersey Mountains, .	15	
	14	6
	13	
Outside, or below Pennsylvania Mountain, .	16	
	17	
	18	6
	19	6
Muddy Bottom,	20	
	21	6

	Feet.	Inches.
	23	
	24	
Sandy Bottom,	27	
	33	
	35	
	36	6
Jersey Mountain Rocks dipping at a steep inclination into the River, ...	38	
	31	
	38	6
	33	
	30	
	32	6
Sand and rocks,	31	6
	33	
Outside the Gap, Sandy Bottom, . . .	37	6
	37	
	36	
	35	
	30	

The river decreases regularly in depth to the rapids below the Gap.

Opposite the "Indian Ladder," in a cove near shore, several soundings were made; the greatest depth of water was found to be 45 feet.

Mr. Peale observed that marks of water action were observable on portions of the rock at a considerable elevation above the present bed of the river; but if the theory of erosion, for the formation of the Gap, be accepted, a difficulty is presented by the depth of the water in the Gap, as shown by the soundings in the foregoing record, and the consequent gentle flow of the current; whilst at the distance of one and a quarter miles above and five hundred yards below the Gap the rapids occur, with insufficient water to float the rafts, which, consequently, are obliged to await the spring and fall freshets.

The constant rise of gas, observable from the deepest parts of the water, was also adverted to, as having a possible action in the formation of the Gap.

Remarks on the cause of the gaps and their relation to the general structure were made by Mr. Lesley.

Stated Meeting, December 2, 1864.

Present, twenty-six members.

Judge SHARSWOOD, Vice-President, in the Chair.

Mr. Hilgard, Mr. Harrison, Mr. Joseph Lesley and President Smith, of Girard College, were introduced to the presiding officer, and took their seats as members. Captain Goodman, of the New Hampshire Historical Society, and Mr. L. Thurlow, of Wilkesbarre, were also introduced.

A letter addressed to the President by a claimant for the Magellanic Premium, but without the required sealed packet, accompanying the claim, was read, and on motion, laid on the table. It described an invention for the safety of passengers at sea, and was illustrated by a model.

A letter accepting membership was received from Mr. R. H. Lamborn, dated Altoona, November 17th, 1864.

Donations for the Library were received from the New Hampshire Historical Society; the Franklin Institute; Captain Goodman, and Mr. Lamborn.

The death of the Hon. Roger B. Taney, Chief Justice of the United States, a member of this Society, on the 12th day of October, 1864, aged 87 years, was announced by the Secretary, and on motion, Judge Sharswood was appointed to write an obituary notice of the deceased.

The death of Professor Benjamin Silliman, a member of this Society, at New Haven, November 25th, 1864, aged eighty-four years, was announced by the Secretary, and Professor Pierce appointed to prepare an obituary notice of the deceased.

A photograph and description of the Great Pittsburg Gun, now mounted at Fort Hamilton, was communicated by Mr. Lamborn, with the following letter from Mr. Charles Knap, dated Fort Pitt Foundry, Pittsburg, November 4th, 1864.

The idea of a twenty inch gun was conceived by Major T. J. Rodman, of the Army Ordnance Corps, and the gun in question was designed by him, and made after his method of "Hollow Casting." It required for its manufacture, new furnaces, cranes and lathes, full

descriptions of which were given in the Philadelphia *Press*, of February 12th or 13th, 1864.

The gun was cast on February 11th, 1864, from three large furnaces, containing 80 tons of iron. It was cast hollow, and cooled by means of a stream of cold air forced through the bore from an ordinary fan. Air was preferred to the usual stream of water, on account of the great size of the mass, which increased the danger of creating a dangerous amount of shrinkage. The second twenty inch gun, however, made for the Navy, was cooled by water, without injury.

The cooling occupied two weeks.

The principal weights and dimensions of the gun are as follows, viz.:

Rough weight, ...	160,000 pounds.
" length, ...	25 feet, 8 inches.
" maximum diameter, . . .	66 "
" minimum "	48 "
" diameter of bore, ...	19 "
Finished weight, ...	116,497 pounds.
" extreme length, ...	20 feet, 3 inches.
" " " of bore, . .	210 "
" maximum diameter, . .	64 "
" minimum " . . .	34 "
" length of elliptical chamber of bore,	15 "

The trunnions were set over the centre of gravity of the gun.

All of the calculations of weights and centre of gravity, made by Major Rodman, and verified here, proved from the results to have been extremely accurate.

The iron used was all made in Blair County, Pennsylvania, and was the best quality of warm blast charcoal pig, remelted once into second fusion pigs, from which, the gun was made.

Specimens from the head gave a density of 7.31 and a tenacity of 36,000 pounds per square inch. A specimen from the breech journal gave a density of 7.3715 and tenacity of 43,746 pounds per square inch. The density is taken with distilled water, and reduced to the common comparative standard of 60° F.

The cost was about $32,000; others could be made much cheaper.

From the commencement of the first preparations to the completion of the recent trial at Fort Hamilton, New York, not a single error or mishap has occurred, to mar the complete success of this last enormous stride in advance of all experience in Artillery.

Letters were received from Professor Zantedeschi, dated Padua, September 11th and November 7th, 1864, a translation of one of which was read, as follows:

I have the honor to forward to your honorable Society, a copy of my letters on the origin of the dew and of the hoarfrost. I here briefly sum up the principal heads of my observations. Can these, my sheets, be published in the Transactions of the Society, my studies may gain such notice, that physicists on the virgin soil of America may repeat my experiments. Remote from the polemics, I confine myself to the fundamental facts of science.

The mode of the manifestation of the dew and the hoarfrost; its sublimation from the soil, from the hour next the setting sun up to the following morning, in the hour next the sunrise, which is the hour of greatest cold, was the subject of my first series of experiments; the circumstances which accompany these phenomena (meteora) were diligently examined in all the calm and serene nights, in which in Italy and in the environs of Paris I made my observations. I find that there is a limit, beyond which dew and hoarfrost is not sensible; and that the limit varies with the variations of the grade of humidity and temperature of the air.

With comparative experiments I have determined whence proceed the aqueous vapor necessary to form dew and hoarfrost. It comes neither wholly from the air by refrigeration, nor wholly from the earth. The greater part rises from the earth, to which is added afterwards, some from the supersaturation of the air; and, it ought not to be forgotten, some from evaporation from the leaves of plants, which is in least quantity. The mean relative humidity of the garden, in which I made my observations, was 55 degrees of the Hygrometer of Saussure. The Hygrometer which received the humidity of the air alone, never rose during the hour of greatest cold to 70°; the Hygrometer which received the moisture from the air and from the earth, went up to 95°; and the Hygrometer which received the moisture from the earth and from the leaves of some small plants, reached the maximum of humidity, 109°. In this way I discovered that the relative humidity of the air was 50°, that of the earth 25°; that of the evaporation of the leaves of plants 5°. These numbers are not absolute. They will vary with the various circumstances of the atmosphere; those of temperature of relative humidity, in nights continually calm and serene; but in all circumstances the abundance of aqueous vapor coming from the earth, was

always greater than that from the supersaturation of the air; and that from the evaporation from plants was always less. The experiment seems entirely new and decisive.

I studied with repeated and laborious experiments to determine the source of the cold necessary for condensing the aqueous vapor forming dew and hoarfrost. By comparative observations I have convinced myself, that the frost of the air precedes that of the moist solids, and that the moist solids do not chill below the temperature of the circumstanding air, taken at the mean height, always in calm and serene nights. It was made apparent by my vertical balance Anemoscope that the nocturnal frost derived itself from the column of cold descending air. I recognized the fact that the surface of the soil, and even of the snow covering it, is always colder than the stratum of air above it; and that with every departure from this stratum the temperature of the air is increased. In all these *facts*, I have done justice to all the physicists who have preceded me, and I register that which is granted to my observations and experiments from my friends.

I have not forgotten to verify the influence exerted by electricity on the deposition of aqueous vapor on solids. I finish these my letters, with two useful applications to Agriculture and to Hygiene, always under guidance of history and experience.

I beg physicists living in the open country in serene and calm nights to repeat all these observations, which complete the theory of the dew and the hoarfrost. May this, my request, obtain favor from your honorable Society, to which, I declare myself with the highest esteem and perfect observance, ZANTEDESCHI.

PADOVA, September 11th, 1864.

An enamelled portrait of a French gentleman, concealed in the bottom of an inkstand or wafer-box, and thrown out by the workmen in digging the foundation for an enlargement of a house, originally built in 1785, at Valley Forge (the headquarters of General Washington, in the winter of 1776), was exhibited to the members by Mr. T. P. James. The relic is, apparently, a work of art of the age of Louis XVI; and much pains has been fruitlessly expended for its identification, both in Europe and in this country.

Mr. Dubois placed before the Society, specimens of Magnesium, lately procured from London for the Cabinet of the Mint, and for experiment.

Magnesium wire is not an entirely new article in this country; but perhaps the ingot is so, and is especially curious. Of all the metals which remain fixed in open air, this is the lightest; the sp. gr. being 1.70, or less than one-twelfth that of platinum, which stands at the other extreme of the scale (and of which a specimen weighing one-third more than the magnesium, is shown for comparison).

This metal is now readily manufactured in England, by a process patented in 1863, and is sold in London at a price equal to $5.25 in gold, per ounce, av'd. Its physical properties are such as to give little promise of utility, except for the purpose of illumination. A wire of this metal, held in an ordinary flame, ignites and burns with a dazzling brilliancy, giving out a white light. On this account it is used in photography, to take pictures at night, or in places where the sun cannot penetrate. The wire appears ductile and pliable, but has really not much tenacity, and snaps off when bent around to the horseshoe shape. It is, in fact, not formed by rolling and drawing, but by the hydrostatic press, from the solid cake; somewhat as lead pipe is made. This specimen has a diameter of one-sixtieth of an inch. One hundred inches of such wire will weigh about fifteen grains, and would cost eighteen cents (gold) in London, at the rate above stated.

The metal being too brittle to be cut with a chisel, this piece of ingot, as will be seen, has been detached by sawing.

Mr. Eckfeldt has made a pretty full examination of its chemical properties, which will here be briefly summed up.

It is slightly soluble in sulphuric acid of commercial strength; the action is violent when the acid is diluted.

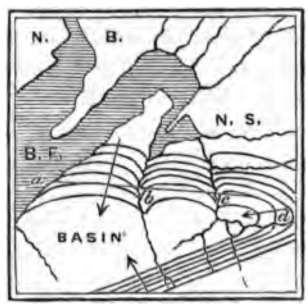
The solution is active and complete in nitric and muriatic acids of ordinary strength.

It is also dissolved by the vegetable acids, such as the acetic and tartaric, but slowly by the oxalic. In a solution of carbonate of soda it dissolves very slowly, but more actively with heat, when it is converted into a carbonate. In caustic potassa there is no action.

It is not affected by water, either at 60° F. or at the boiling-point, except to produce a slight tarnish. The water, however, is decomposed by it. Moist air makes a slight oxidation. These specimens came across the ocean, however, in a paper box, without losing the metallic lustre.

The Librarian communicated an extract from a letter of Mr. W. A. Hendry, of the Crown Land Office, at Halifax, respecting the discovery of a large bed of coal among the lean beds of the Joggins and Albert Mine regions:

"No new discoveries have been made, since you were here, except perhaps at the Spring Hill, which I visited two months ago. You recollect its position on the map. A discovery has been made of a seam of coal, said to be 16 feet thick. I myself measured nearly 14 feet; but 16 and 18 feet has been currently reported as the thickness of the great coal-seam of Spring Hill. The bed, with thin clay partings, gives from 12 to 14 feet of good bituminous coal. I am well acquainted with the gentlemen who are geologists there, Messrs. Mills & Sherer." It is well known that of more than a hundred coal-beds outcropping among these measures on the coast of the Joggins, not one is much more than 4 feet. It is noticeable that this large increase in the size of one of these beds, that at Spring Hill, takes place at the head of a synclinal axis, towards the east, as shown in the diagram.



B. F. Bay of Fundy.
N. B. New Brunswick.
N. S. Nova Scotia.
a. The Joggins Mines.
b. The Victoria Mines.
c. The Macan Mines.
d. The Spring Hill Mine.

The following summary of the rocks passed through in an old salt boring in Clearfield County, Pennsylvania, was communicated by the Librarian, from a letter from Mr. John M. Hale, of Reading. The Librarian remarked, in offering the section, that, it was one of the most useful duties of learned Societies to obtain, and place on record, the too easily lost or destroyed results of the labors of the past.

"Some twenty-five years since, a company bored for Salt Water, at the junction of the Beaver Dam and Eastern branches of the Clearfield Creek, where a natural salt lick existed, and employed Mr. S. G. Wilson to superintend the operations; and to him I am indebted for a copy of his notes, a synopsis of which I thought might be interesting to you, if you have not seen them.

"The first 23 feet was through the clay, where the rock was struck, 7 feet of which was black slate, followed by 6 inches of Bituminous Coal. At a depth of 32 feet, 6 inches, a vein of fire brick rock was struck, which was 13 feet in thickness, and which appeared in the lower part of the vein to be mixed with Iron Ore. The next 5 feet, of black slate mixed in with coal, followed by 1 foot of white flint rock, then 2 feet, 6 inches, of black slate, when a vein of Cannel Coal was struck. This was at a depth of 53 feet. Next, 8 inches of slate, which separated the Cannel Coal from a vein of bituminous coal, 4 feet, 4 inches, in thickness. Then 14 feet of common sandstone, and 2 feet mixed with slate and coal. Then a vein 60 feet in thickness of Porcelain Clay, of a very superior quality, resembling white lead, ground in oil. The next 135 feet was through common sandstone, changing in color from brown to black, and mixed with quartz. Again the auger passed through a vein of 5 feet of Porcelain Clay. The balance was through a vein of hard sandstone, a portion of which was mixed with a yellow metal, which was believed to be copper. Unfortunately, the only specimen saved by Mr. Wilson, was lost. Was it Iron Pyrites?

"At the depth of 548 feet, salt water was reached, but so mixed with a dark fluid that it was believed to be useless. Was this dark fluid Petroleum?

"The veins of coal may be the same as those at Oseola, or the one at Philipsburg passed through at a depth of 199 feet."

Mr. Peale took this occasion to exhibit to the Society some fragments of ancient vessels of pottery of large size, and still conserving the impressions of the osier wickerwork baskets, by which they were ornamented. They were found at ancient salt springs in Gallatin County, Illinois, and are made of clay, in which remain visible fragments of fresh-water shells, mixed in to strengthen the clay.

Large quantities of comminuted shells and broken pottery remain near the springs, with other evidences of ancient salt works, of which there is now no knowledge, either recorded or traditionary.

The style of the ornamentation is entirely distinct from that of the Indian pottery of recent date, and the vessels much larger than any made by that race. The inference drawn from these facts is, that they are the reliquæ of the Mound Builders, a race much more advanced in the arts than those which succeeded them.*

* [These fresh-water shells are brought up in evidence by Mr. Winchell, in his

Mr. Lesley announced the discovery, just made, of a remarkable lignite deposit, close to the ore-banks of the Mont Alto Furnace, in Franklin County, Pennsylvania; but owing to the lateness of the hour, begged leave to postpone the exhibition of the specimens on the table, and the description of the deposit, to the next meeting.

The stated business of the meeting being called for, the Treasurer's report was read, and regularly referred to the Finance Committee.

The report of the Publication Committee was read, and referred to the Finance Committee.

The report of the Board of Officers on the application of "Torricelli" for the Magellanic premium was read, and, on motion of Mr. Fraley, it was resolved, that the subject be ordered for discussion at the next meeting of the Society, and that notice be given to the members on the cards, and an advertisement be made for three days before the meeting, in two daily newspapers.

New nomination No. 529 was read.

And the Society was adjourned.

Stated Meeting, December 16th, 1864.

Present, twenty-one members.

Dr. Wood, President, in the Chair.

A letter declining the appointment to prepare an obituary notice of Prof. Silliman, was received from Prof. Pierce, dated Cambridge, December 18th, 1864.

lately published paper on the structure of the prairies; wherein he argues that the prairie deposit was made in a preglacial lake, overspreading the whole Valley of the Mississippi, as far south as Middle Alabama. *Sill. Jour.*, Nov., 1864. Sec.]

Letters of acknowledgment for publications received were read from the Lombardy Institute; R. Saxon Society; Herr Jochmann; the R. Danish Society; the N. H. S. at Emden; the R. Academy at Amsterdam; Batavian Society at Rotterdam; Sir John Herschel; the Lords of the Admiralty; the Society of Arts, and Society of Antiquaries of London; the Natural History Society of Northumberland; the Smithsonian Institution; and the Chicago Historical Society.

Letters of invoice were received from the Societies at Leipsic, Emden, Upsal, Copenhagen, and the Academy at Amsterdam.

Donations for the Library were received from the Royal Societies and Academies at Upsal, Copenhagen, Leipsic, Emden, Amsterdam, Rotterdam, Milan, London, and Dublin; from the German Geological and French Geographical Societies; from Friedlander & Son of Berlin; and Fr. Miller of Amsterdam, booksellers; from Prof. Steenstrup of Copenhagen; Prof. Zantedeschi of Padua; and Elia Lombardini of Milan; from the London Chemical Society, and Sir John Herschel; from the American Academy at Boston; and Essex Institute at Salem; J. E. Cooley, bookseller; and James T. Hodge, geologist, of New York City; the Academy of Natural Sciences, at Philadelphia; the Franklin Institute, and Mr. M. C. Lea.

The Librarian was authorized to complete the set of Proceedings for Sir John Herschel, at his request.

On motion of the Librarian, after reading a letter from Prof. Daniels of Chicago, the Academy of Science at Chicago was placed on the corresponding list.

The death of one of the oldest members of the Society, Mr. Ross Cuthbert, of Berthier (Lanorais), Lower Canada, was reported by the Secretary, on the authority of a private letter from Prof. Hunt of Montreal, as having taken place in 1861.

The death of another member of the Society, Mr. Henry Rowe Schoolcraft, in Washington, on the 11th inst., aged 72, was announced by the Secretary.

Prof. Cresson was excused from preparing an obituary notice of Mr. Waln.

Mr. T. P. James read a paper on the New Mosses which he had detected within the limits of the United States, east of the Mississippi River, intended for the Transactions. On motion the paper was referred to a Committee consisting of Messrs. Durand, Porter of Lancaster, and Aubrey H. Smith.

Mr. Lesley described a recent discovery of Lignite in iron ore at Pond Bank, ten miles east of Chambersburg, in Franklin County, Pennsylvania, and described the importance of the discovery in a theoretical point of view, its analogy with the Brandon deposit in Vermont, and its influence on the determination of the age of the present surface of the land. Specimens from the deposit were exhibited to the members. Mr. Lesley said:

A few days ago, a remarkable instance of the discovery of a tertiary deposit among the Appalachian mountains, similar to that of the celebrated Brandon lignite deposit, in Vermont, has occurred in Southern Central Pennsylvania. The geological importance of these two cases, so far as I am aware the only two on record, can hardly be overestimated. They open again, in the most embarrassing manner, the discussion of the age of the present Silurian, Devonian, and Carboniferous surface. They suggest an entire revolution in the generally accepted modes of regarding the production of our Appalachian topography. They lend a novel interest to the glacial hypothesis; and they help to settle our views on the difficult subject of the confinement of the New Red within its well-known limits, along the south foot of the South Mountain or Blue Ridge range, which I discussed in a brief manner, at the last meeting of the Society.

The lignite was struck in a shaft, at a depth of 40 feet below the surface. It was between 4 and 5 feet thick; under it a stratum of very solid gray sand,* of equal thickness (5–6 ft.); and then lignite more solid and glossy, for seven feet more, to the bottom,† as far as sunk. I have not been able to visit the place, and give this description as it is reported by the shaft-sinker. Large logs of wood were taken from the deposit, specimens of which, I have the pleasure of

* ("Like disintegrating sandstone.")

† ("With here and there a thin streak or vein of hard gray sand.")

exhibiting to the members present. The rings of growth, the rays, and the bark fibre, are as visible as in a fresh butt. The wood is converted partly into a brilliant cannel coal, and the rest of it into common brown coal. No leaves or fruit have as yet been noticed by the workmen; although such may have been overlooked, from want of knowledge of their importance.

It is possible that a large body of this material may exist just where the shaft happened to be sunk; for the Brandon deposit is a mass about 25 (twenty-five) feet square, descending steeply through a hundred fold larger mass of white clay, to a depth of at least 100 (one hundred) feet. But we cannot call it a large body *comparatively* speaking. It is scarcely larger than the trunk of a single one of the giant trees of California; a mere plug of coal thrust vertically downward into a mass of clay. But Prof. Hitchcock expresses the opinion that the Brandon deposit is not "a vertical plug," but a fragment of a regularly steep-dipping stratum of lignite. He dissents expressly from my own view of the case (published in 1857, after I had visited the locality), when he says: "Mr. Lesley imagines that the Brandon deposit is in a hole, like that in Balamacadam, in Ireland. But if he will visit the former, he will find it no more and perhaps rather less in a hole than the other analogous deposits scattered for two hundred miles along the west base of the Green Mountain range. They generally occur in depressions in the limestone floor, or in sheltered valleys, and this is probably why the drift agency did not sweep them away."*

The venerable and candid geologist whose loss we have been called upon so recently and so heartily to deplore, would have taken, perhaps, more delight in the discovery near Chambersburg, than any other man living; and I regret with a very sad feeling the impossibility of comparing notes with him once more upon this old ground of dispute. For he would probably now be convinced that the different facts involved in this phenomenon must be separated; and that we have to keep our eyes open to several collateral but independent trains of geological accidents. The Lignite and the Iron-ore are neither of the same age, nor, strictly speaking, possessed of any structural attribute common to both. I have, therefore, regarded only the lignite deposit as "in a hole;" not by any means the iron ore. This latter I have long ago described as continuously stratified. When Dr. Hitchcock, therefore, in the above quotation from his report, says, that I will find it no more and perhaps less in a hole than the

* Geology of Vermont, 1861, page 238, lines 4–6.

other analogous deposits, &c.," he cannot mean to affirm anything of the lignite; for there are no other analogous *lignite* deposits known, except only the ore which I bring to the notice of the Society to-night. And I expect to receive the evidence, that it also is truly "in a hole;" that is, it will probably be found to be as curious an exception to all the rest of the phenomena of the whole belt of hematite deposits of the Great Valley, for many hundreds of miles in Pennsylvania and Virginia, as the little plug of lignite at Brandon is an exception to all the other features not only of the great Brandon ore bed, but of all that belt of similar ore beds which ranges for several hundred miles through Vermont, Massachusetts, and New York.

Geologists will appreciate the assertion that it is the extreme rarity of these lignite apparitions in one of the most wonderfully continuous, extensive and valuable ore belts of the world, that gives them all their importance, and produces all our embarrassment. It is therefore of prime importance to make sure of this fact, viz., of the actual rarity of the presence of lignite, or its equivalents, in the ore deposits, and to keep this rarity always in mind, in discussing the age of the ore belt itself; but this Dr. Hitchcock has not done.

On pages 234–236 of the Vermont Report, he says; "Wherever we have found brown hematite and manganese, or beds of ochre, or pipe clay, white, yellow or red, in connection with coarse sand or gravel, all lying beneath the drift, and resting on the rocks beneath, we have regarded the deposit as an equivalent of that at Brandon just described, even though not more than one or two of the substances named be present." The peculiar feature of the Brandon mine is therefore ignored by being confused with others, common to the whole belt.

Dr. Hitchcock gives a list of 26 such deposits along the western side of the Green Mountain range, premising that: "from Stamford through Bennington, as far as Middlebury, it would probably not exceed the truth to represent it as a continuous narrow belt. North of Middlebury the localities are few, perhaps from denudation." Yet along this "probably continuous" belt, he can enumerate, with exception of the Brandon mine, only *one*, that of East Bennington, which exhibits even so much analogy to a lignite deposit as "pipe clay with numerous stems of plants;" and only six others, wherein white clay, ochre, ochres and clay, or lithomarge, suggest to his mind an analogy with the Brandon kaolin.

Now it is quite as safe to call the continuation of the line of the Vermont ore deposits, through Massachusetts, New York, New Jer-

sey, Pennsylvania, Maryland, Virginia, and East Tennessee to Alabama, "a narrow continuous" belt; for, with one exception, hereafter to be described, it is really such. And it would be quite as difficult to point out another deposit strictly "analogous to the Brandon lignite," along all these many hundred miles, excepting the one just discovered in Southern Pennsylvania. There may be others not yet made known. But a great number, literally thousands of shafts, and open quarries, have been made in this ore belt in these different States, during the last hundred years, from some of which hundreds of thousands of tons of stuff have been excavated; and yet even the presence of a fossil leaf, or any other slight trace of tertiary vegetation, is almost or quite unknown. Quantities of dark and even black clay have been obtained; but in all instances, so far as I am aware, the coloring matter has been manganese rather than carbon. The future may reveal much which we do not expect; but enough has been done to prove the rarity of lignite in the ore belt.

We must therefore carefully separate these sporadic occurrences of lignite from the general occurrence of iron ore, in our discussion.

I think it can be shown, also, that we must keep quite as separate the lignite and the clays. And I think it can also be shown that the clays are to be connected closely with the ores, instead of with the lignite, if we are to reach clear views of the whole phenomenon.

These are the principal features of the great ore belt of the Atlantic States:

1. It occupies a narrow strip of surface, along the Great (Lower Silurian) Valley, which begins in Canada, and ends in Alabama.

2. It hugs the southeastern margin of the Great Valley, and lies at and against the foot of the Mountain Barrier, which, as is well known, shuts the Great Valley in from the Atlantic seaboard; a barrier, known by various names, such as the Green Mountains, the Highlands, the South Mountains, the Blue Ridge, and the Smoky Mountains; but which is in reality and geologically considered, one continuous range or ridge of rock.

3. It lies, therefore, over the lower contact of the Lower Silurian limestones with and upon the rocks of the Great Barrier range; and is, therefore, *in some way or other*, genetically involved in that contact. It therefore belongs geologically to the Lower Silurian limestone formation, and especially to the lowest member of that formation; and cannot in any sense, *as an ore belt*, be of tertiary age, without a plain violation of the canons of structural geology.

4. It consists everywhere of two parts, more or less easily dis-

tinguished; the one stratified in the same sense as the Silurian limestones themselves; the other a surface-wash over the basset edges of the first. The date of the formation of this local surface-wash may be tertiary, and perhaps post-tertiary. The stratified portions must be, as to their stratification, of Lower Silurian age; while the metamorphism which they have undergone, *in situ*, productive of stratified clays and ores, *may date from any time subsequent to the formation of a surface topography approximately identical with that which now exists.* The actual change of the original Lower Silurian calcoferriferous sandstones and slates, *in situ*, at their outcrops, into limonite clay beds, *in ipso situ*, stratified as before, but charged with an additional percentage of the oxides from a former higher surface now eroded, and with this extra charge of iron and manganese carried by percolation down to and crystallized against their foot rock,—this change may have required an immense time to perfect, and no doubt was going on, *pari passu* with the degradation of the surface by slow erosion, from higher to lower levels, until it stands at the level of the present day.

This long era of *iron ore concentration*, in the Lower Silurian slates, could not have commenced until after the close of the coal era; and I will be able to show, I think, not until after the close of the New Red or Middle Secondary age. It may have been commensurate with the Cretaceous, Tertiary and Recent periods together; or with the Tertiary or the latest Tertiary and Recent alone. But it seems more likely, in view of the geographical relationships of the New Red to the Silurian on one side of it, and to the Cretaceous on the other side of it, that the erosion of the surface commenced at the close of the New Red era, and continued without intermission down to the present day. There is no sufficient evidence of the submergence of the Atlantic side of the Continent, since its emergence after the coal. There is not a trace of New Red, Cretaceous, or Tertiary deposit recorded by any geologist, so far as I am aware, over all the country back of the Great Barrier range, from west of the Hudson, until we reach the prairie lands of the Mississippi Valley. There were, of course, New Red rivers, Cretaceous brooks, Tertiary freshets, Glacial ice; but these carved out the present surface-topography of the Appalachians, without leaving a plant, an animal, or even a pebble which can be recognized as belonging to any special age. In fact, the New Red surface must have been largely remodelled, lowered, and denuded of New Red relics, by the Cretaceous agents; and the same liberties were no doubt taken with the

surface of the Cretaceous age, by the sweeping and garnishing artists of Tertiary times. Little by little the whole sloping mean horizon of water-level, from the Alleghany Mountain to the South Mountain, was lowered to its present line. The gaps were gradually deepened, widened, and rounded off to correspond with the slow deepening of the limestone and slate valleys behind them; and the long strait narrow sandstone crests of the mountains of IV and X and XII (Middle Silurian, Upper Devonian, and Carboniferous), were gnawed away evenly at a slower but not less steady rate.

It was Professor Rogers's opinion that all this was, so to speak, the work of a moment; the consequence of the rush of a large body of water over the face of the Continent, at the time when the coal era was abruptly brought to a termination by the upheaval into the air of the whole Appalachian belt of earth-crust, when it was thrown into waves or folds; after which the once horizontal strata remained partly or entirely upright.

With this cataclysmic hypothesis I cordially sympathized for some years; and some of the geologists of the Pennsylvania survey, I believe, still do so. Nor am I yet entirely convinced,—it may be from the force of a strong and early prejudice,—that such a cataclysm is not indispensable to explain the earlier and perhaps the larger part of the whole phenomenon. Not that I ever accepted that part of Mr. Rogers's statement of it which gave an account of the *modus operandi* of the anticlinals, viz.: by a pulsating planetary lava-nucleus. But the study of the surface itself, covered with mountains and valleys, arranged in a beautifully symmetrical manner, by whatever energy you please,—and I have always thought the lateral thrust of a cooling and shrinking crust one sufficiently plain and precisely explanatory of the details,—in fact, the study of these details, some of which offer the most inviting problems of erosion to the structural geologist, has impressed upon my mind the conviction that aërial and fluvial agents are not the *kind* which could have *begun* the great work of Appalachian erosion. Give them time and they are omnipotent, I grant, *but only in their own sphere.*

It would lead too far to argue this part of the subject here. I only wish, when I describe the whole water-shed horizon of the Appalachians as being step by step lowered during later Secondary, Tertiary, and Quaternary times, to guard against that total rejection of cataclysmic agency which has come to characterize the geological speculation of the present day upon great structural questions. This fact, evidently true in itself, is also necessary to the argument respecting

the Tertiary age of the iron ore beds containing lignite. In fine, it is the main fact of the discussion.

The gradual lowering of the main surface-plane involved, 1st, the obliteration of all grand original inequalities which would have been produced by a grand original cataclysm, if a cataclysm be allowed; and, 2d, the production of a new set of inequalities, due partly to structural relations of movement, such as folds and faults, but chiefly to the different *homogeneousness*, the different *compactness*, and the different *insolubility* of the formations. These three chemical and lithological differences, of course, produced our present mountain, hill, and valley surface. It is evident, then, that the reason why the southeast side of the Great Valley is everywhere lower than the northwest side, is because it represents the more soluble and less compact outcrop edges of the Lower Silurian limestones No. II, while the other, or northwest side of the Great Valley, consists of Lower Silurian slates No. III. In fact, the Great Valley may be said to be as to the northwest half of it paved with low hills. These are the slate hills of that half of the valley which lies up against the North (Kittatinny, Blue or Brush) Mountain. The southeast half is a nearly perfect plain, cultivated like a garden, and exhibiting in the fields numberless low ledges of limestone rock, beside many of which stand limekilns.

There are certainly evidences of some obscure nonconformability between the limestones of II and the slates of III above them; for, while the strike of the slates is always straight up and down the Valley, that of many groups of these limestone-outcrops is perversely out of line, often crossing the valley at various and sometimes at right angles. But much of this apparent nonconformability is no doubt due to crimpling, although the whole formation is much more nearly horizontal than it has had credit given to it for being; and much of it is a deception, produced by an extraordinarily well-developed system of cleavage-planes. On the whole, the regularity of the bounding mountains, and the symmetry of the Valley itself, are good guarantees against any serious nonconformability.

Before the beginning, and again, after the close of the *limestone* Lower Silurian age, there were depositions of ferruginous mud, causing two slate formations, a lower, No. I, and an upper, No. III. The contact of the limestone and the upper slate, along the central line of the Valley, is marked by a range of iron ore. In a few instances it is abundant and largely excavated for the furnaces of Pennsylvania.

The contact-line of slates just under the limestone No. II, with

the lowest sandy layers of the limestone, gives us likewise a second great belt of iron ore deposits, lying along the foot and part way up the side of the South Mountain. These are the deposits of which Professor Hitchcock speaks in Vermont; and in one of these in Pennsylvania, viz., in the Pond-bank of Mont Alto Furnace, the lignite has been found.

Along the foot of the South Mountain, the feebler brooks, descending from the ravines, sink immediately beneath the surface into a system of underground caverns, which may, without much exaggeration, be called a single cave, extending for a thousand miles, and including in its course chambers, some of which, like Weir's Cave, in Virginia, have become celebrated among the wonders of the world. The stronger brooks unite, and form large streams, or even rivers, which,—like the Lehigh below Allentown, the Yellow Breeches west of the Susquehanna, the Shenandoah south of the Potomac,—flow close over the southern or lower edge of the limestone formation, and therefore close up to the foot of the mountain.

Both this situation of the river drainage on the surface, and this cavern system underneath, tell one story, which cannot be misinterpreted,—the *extra dissolubility of this particular horizon of Lower Silurian rocks.* And that, which we now see going on before our eyes, has, of course, been going on for ages. The fissures which are now being enlarged into caves, and the caves which are fast growing into catacombs, and ramifying into labyrinths of underground darkness, their roofs every now and then falling, so as to produce funnel-shaped sinkholes in the fields and sometimes in the roads, and their floors receiving, through the sinkholes, lots of leaves and fruit, land shells, and perhaps occasionally bones of smaller animals, with every great spring freshet,—all these once had their analogues in time past (vanished now into thin air) beneath some old surface, situated many feet or yards, in fact many fathoms, above the one on which men live to-day.

By this ideal reconstruction of surfaces older and above the present one, we settle most of the difficulties which encounter us in studying the ores of the Great Valley. And I submit, that we obtain, also, a reasonable explanation of the sporadic masses of lignite, two of which are now known to exist in or rather near the iron ore; for it must not be forgotten that the lignite and ore are not in contact at either place. It is only necessary to suppose a sink hole so formed, and so stopped up below, as first to receive and then to retain an accumulation of forest trash, and we have the thing ready

made to our hand. The fact, that it occurred just under, in, or near a great ore deposit, must be regarded as an accident, until we have found enough more lignite deposits connected with ore beds to make some organic or original connection between them supposable. And even then, it must be remembered, that the search is wholly confined to the ore-deposit localities, which of itself would throw doubt upon their connection, even if we had a sufficient number of instances.

I will now give as clear a description as I can of the ore banks of Mont Alto, so as to show, if possible, the actual relationship of the lignite to the ore; granting, in advance, that the description will leave much to be desired.

The brown-hematite ore-deposits of Mont Alto follow the outcrop edges of the slates and sandy limestones which form the southeastern edge of the Valley, as shown in section, Fig. 1, Plate VIII. The ore is in fact nothing but the residue of these beds after decomposition and dissolution, the honeycombed and altered edges of the Silurian slates and sand-limes themselves, after their lime has been washed out of them, and their carbonated and sulphuretted iron has been hydrated and peroxidized. The muddy slates formed the present deposits of small ore with white and red clay. The sandy limestones formed the present harder, silicious, rock-ore belts. The geologist can procure, in the banks, specimens of every stage of this interesting process, from the perfect limestones which refused to disintegrate, and the iron-lime-sandstone with the disintegration and recrystallization begun, to the perfect ball and pot ore of radiated, acicular, crystallized brown-hematite. The great variety in the composition of the original rocks has been the cause of a great diversity in the ores taken from the different openings. But two principal distinctions may be particularly noticed; viz., that the ores which have resulted from the decomposition of the slates are more disposed to the *redshort* side, whereas the ores which have resulted from the decomposition of the limestones are more or less *coldshort;* probably because of the sand in the limestone; it is, in fact, called by the New York geologists the Calciferous Sandrock. The slates, on the contrary, are apt to hold a small percentage of sulphur; or perhaps we should say, are less likely to permit the abundant drainage needful for carrying off the sulphur in the form of a salt. Sometimes in the same deposit there is a mixture of the two varieties, producing a neutral ore. But it is not often that such large exposures of both varieties occur in the same neighborhood, as is the case here.

Taking into view all that we know of these deposits along the

southeast side of the Great Valley, from the Hudson river to Tennessee and Alabama, and adding what we know of similar deposits, produced in a similar way, out of the exposed outcrop edges of the same rocks in the limestone valleys further back towards the Allegheny Mountains (such as Kishicoquillis, Nittany, &c.), and deposits, in the same geological positions in Lancaster and Chester counties, we can divide them with great certainty, as stated above, into two classes, the *slate-crop banks*, and the *sand-lime-crop banks*, the former being always geologically underneath the latter, as represented in Fig. 1.

The cavernous condition of the formation which crosses the Antietam creek at Mont Alto is evinced by the numerous sink holes and ponds lined with clay, and by the absence of small streams, and by the curious topography of the whole slope of the South Mountain, the want of any definite run to the vales, the bowl-shaped aspect of every part of the surface, and the disappearance of the mountain brooks on their way towards the centre of the valley. In other valleys (as e. x. in Sinking Creek Valley, near Altoona) the number and the extent of the caverns astonish and delight the beholder. Where the dip of the rocks is steep there is not the same chance for the formation of caverns; and the depth to which the disintegration of bed, in other words, the formation of ore, can go, is necessarily limited. On the contrary, where the dip is gentle the dissolution is extensive, and the ore abundant.

Within the first half mile there have been excavated several large pits. The bank at present wrought is 2200 feet from the furnace. It is called the Home-bank, and furnishes the principal data for estimating the quantities of ore in the whole belt, Fig. 2.

The excavation is between one and two hundred feet long, and of the shape shown in the figure. Its mouth is a cartway between walls of surface clay or common stripping. Its head is a steep slope of clay, covering ore, from 40 to 50 feet high, behind the top of which rises the mountain side 50 feet higher, to a gently sloping terrace, as shown section, Fig. 3.

As there are but from 5 to 10 feet of stripping, and the ore in fact sometimes comes within that distance of the surface, the plan shows at a glance the immense extent of the ore ground. The new workings are ordinary gangways, timbered and lagged where needful, with cross galleries driven to the right and left, in an irregular manner, but so as to leave 50 foot pillars of ore between them, and not kept carefully upon a level. In fact, one of the gangways to the

right rises so fast as to overrun the timbers of the old tunnel (See Fig. 2) which is driven into the face of the quarry at a level 20 or 30 feet higher than c. Another gallery has a shaft 30 feet deep at its end. The whole mine is in fact nothing but an extensive shaft exploration, leaving the mass of the ore untouched. We have, therefore, data in sight for the following calculation:

Quantity of Ore in the Mine, in Sight.

Galleries one way, 200 + feet = 70 yards, Galleries the other way, 150 feet = 50 yards, Average height above tunnel, 50 + feet = 17 yards,	say 60,000 cubic yards.
Add length of quarry, 150 + 150 feet = 100 yards, Take same breadth as above (200) = 70 yards, Depth of shaft in quarry, (70 +) = 25 yards,	say 175,000 cubic yards.
To which add for quarry slopes, &c.,	say 15,000 cubic yards.
Total in sight of the Home-bank,	say 250,000 cubic yards.

This does not take into account the existence of ore to a greater depth than the bottom of the shaft, 70 feet, where, as the miners assert, they stopped in solid ore; and there is no reason to doubt the fact, seeing 1, that the 30-foot shaft, at the inner end of the side gallery, left off in ore, and the dip would carry it far below the bottom of the 70-foot shaft; and, 2, the bottom of the 70-foot shaft is still 70 feet above the creek at the furnace, and therefore within the limits of underground drainage and decomposition. It is also left out of sight, in the above calculation, that the ore passes outward and downward from the quarry in the direction of x, (Fig. 3), all of which must be added to the sum total above.

Thus, a surface section of the ore belt 50 yards long represents ore beneath it to the extent of, say 250,000 cubic yards.

The mining done in past years from this bank half way to the furnace, and the exhibitions of ore at the surface at the furnace, warrant us in using the above calculation for that distance, viz., 2200 feet, or say 700 yards, = 3,500,000 cubic yards of ore in the ground.

Openings made, also, at intervals, beyond the Home-bank, to a distance of a mile and a quarter from the furnace, will, on the above calculation, increase this quantity to 11,000,000 cubic yards of ore in the ground. There is no reason for doubting that the ore belt continues equally rich to a greater distance northward, along the face of the mountain, past the White Rock Gap, and towards the Conecocheague, at Caledonia Iron Works. But as the surface exposures can never be implicitly relied on, and as the quantity of ore depends more upon the local depth of drainage and decomposition than upon any

other consideration, it is hazardous to extend the calculation further. Towards Quincy and Waynesborough, no good openings have been made in that part of the belt, although the surface is covered with blocks of ore, and the wash ore is seen in the roads. It is probable that as large an amount can be obtained south of Mont Alto Furnace as north of it.

The ore in the ground consists of ball ore and wash ore, with lumps, plates, and streaks of clay. The clay is thrown out where it is in sufficiently large lumps, and the rest of it is washed off. There remains a good deal of clay in the balls, which are irregular globes of hematite, oftentimes hollow, and lined with beautiful acicular crystals, standing apart like the bristles of a brush, but set at an angle with the inside face of the shell.

The ore when washed is about a 50 per cent. ore, the books showing that 4600 pounds of washed ore made a (long) ton of iron.

Professor Booth's analysis gave:

Sesquioxide of iron, ...	75.00
Alumina, ...	1.00
Silica, ...	16.00
Water, ...	8.00

(omitting decimals) with a trace of lime remaining. The iron has always been inclined to coldshort, on account of the silica, and has usually been mixed with ore from the Pond-banks (to be described below), when it makes a very tough iron. Tested in Washington, with three other varieties of iron, it stood as follows:

Tredegar iron sustained	32,000	pounds.
Ulster " "	32,000	"
Glendon " "	34,000	"
Mt. Alto " "	34,000	"

(decimals omitted), the test bar being round, and its section equal to a square of .75 inch.

To get the percentage of lump clay, I calculated the contents of the tip-heap in front of the old tunnel, b, out of which it was taken, and from which were also taken the proceeds of two years' mining for the furnace, say 4000 tons of ore. The tip-heap contained about 100 cubic yards of clay refuse.

I also saw washed 13 barrows of "wash ore," containing no lump clay, and saw that they yielded 11½ barrows of washed ore ready for the roasting pile; = 90 per cent.

The proportion of *lump clay* in this tunnel to *unwashed ore* must have been, say from 5 to 10 per cent, by weight.

The proportion of clay to ore near the surface is greater than it is further down, probably because the drainage from the surface into the already made ore has charged all its vacancies. But whatever be the explanation, the ore-mass becomes denser and richer continually as one descends in the quarry, and the deepest shafts sunk have left off in very hard, pure ore. In the limestone deposits of pipe ore, the lower limit or extreme bottom plane of dissolution is characterized by an accumulation of very pure and beautifully crystallized hydrated peroxide of iron; and all these deposits are, therefore, richest at the bottom. A mass of rock ore lies thus behind the present works, and below them; or, in other words, forming the "foot-wall" or "underlay" to the deposit. This rock or hard ore is struck in the galleries, and is not worked, because it requires blasting; whereas, all the rest of the mass can be picked and shovelled. In the future open quarries, this mass of ore will form the richest part of the work. It is merely a more compact form of brown hematite, perhaps a little more silicious than the rest. The terrace above the works shows much surface ore, and on this terrace come up the slates which hold the Pond-bank ore, hereafter to be described.

Again, outside, or above, or to the west of, the Home-bank belt (B, of Fig. 2), there is a third belt (C), the outcrop of which is shown by a sharp small ridge in a field, covered with blocks of hard ore from one to two feet in diameter. The whole surface of this sloping field, from the little ridge downwards, for a hundred yards, is strewed with this ore, many tons of which have been collected and smelted in the furnace. It is probably in connection with this ore belt that we find an outcrop of almost unchanged blue carbonate of iron and lime, several feet thick, mottled with groups of crystals of white calc spar, and evidently, in parts, changing into honeycomb brown-hematite ore. It lies with a dip of 20° towards the west.

There are evidences of other belts further west still; and a limestone quarry, used for fluxing the furnace, shows a 45° reverse dip (towards the east), by which we know that there is a basin, running along the bottom of the slope of the mountain, and an anticlinal axis west of it, bringing up the ore-bearing formations towards, and perhaps to, the surface; which is sufficient to account for the ore belts just mentioned.

This synclinal axis is the same which runs in between the Little

Mountain and the Main Mountain at the Pond-banks (or rather at the English openings; see the map, Plate IX). The anticlinal axis is no doubt that of the Little Mountain itself, which brings up the slates on the back of the Pottsdam sandstone, and thus produces the grand exhibitions of ore all around it, as shown in Fig. 4.

The Pond-banks and Caledonia-bank, and the English diggings, are several openings of greater or less size in the upturned belt of slates surrounding the Little Mountain, which rises as an isolated ridge, one or two miles long, from the floor of the valley. The English diggings are behind it, the Caledonia-bank before it, and the Pond-banks at its south end, in the plain. The ore mass in the Caledonia-bank dips 5° towards the mountain, but must certainly rise again upon its flank. The English ore evidently dips 10°—15° away from the mountain. The difficulty of estimating the quantity of ore on this ground is very great, on account of the enormous covering of red earth upon it in places. The shape of this deep excavation is that of a crescent, with nearly vertical sides, and an irregular bottom.* Its whole length is about three hundred yards, and its depth to the general floor is from 60 to 80 feet. The ore appears within 10 to 20 feet of the surface, at some points, and at others not for 30 or 40 feet down. Mountains of stripping stand beside it to the west, above where the body of the ore turns over a small anticlinal, and buries itself westward beneath undecomposed limestone. The depth of the ore is still unknown. Shafts from 60 to 110 feet have been sunk in it at the sides and in the bottom of the present excavation. The top of the ore stratum at the extreme north end of the quarry is exactly on a level with the edge of the upper Pond-bank, which is only 5 or 10 feet above the top of its own ore, into which the mining has descended 30 to 40 feet. The lower Pond-bank is on a slightly higher level.

The fact is, therefore, that all these three excavations, separated by only one or two hundred yards of interval from each other, and extending in a line about one thousand yards, are sunk in one deposit of ore; or, to speak more correctly, in the broad overlapping margin of the ore-bearing slate deposit, which sweeps round the south end of the Little Mountain in a nearly horizontal and partly basin-shaped posture.

In the bottom of these excavations the ore is reported as uniformly well compacted. In the upper end (north end) of the Caledonia-

* The sketch Fig. 8, Plate X, was made from the head of the road.

bank at a depth of say 60 feet from the surface, I saw the top of a body of ore which was as solid as a mass of cellular brown-hematite ore could be. In other parts the ore is distributed through clay. The whole is worked with pick and shovel. The large tip-heaps at Caledonia-bank show the quantity of stripping done, rather than the amount of clay mixed with the ore, and the small size of the tip-heaps about the two Pond-banks speak well for a large percentage of ore in proportion to clay.

Taking, then, the length and the width of the three banks for a basis of calculation, and giving only 50 feet as the average depth of the ore, and deducting 50 per cent. for clay (which is very large), we see: 1000 yds.$\times$100 yds.$\times$17 yds.$\div$2=850,000 cubic yards of ore in the ground, from which the extracted ore has been deducted. Starting with this amount of ore "in sight," and applying the calculation to the ore descending on the west, ascending again on the east, outspreading to the south, and filling the little valley behind the Little Mountain, past the English diggings, we get many millions of tons in addition, and under precisely the same conditions, viz. with a variable covering of soil, clay, and loam, say from six to twenty feet thick; nearly horizontal; compact towards the bottom and loaded with clay in places; the ore all in small pots, and shards, and gravel-like pieces; yielding about fifty per cent. of metal, and showing a neutral character, making excellent iron. The amount of clay in these banks is highly in excess of the amount at the Home-banks. On the other hand the amount of silica is less.

The Lower Pond-bank is said to have mined from five to ten thousand tons of ore, beginning within ten feet below the surface, and descending at least thirty feet, without bottom.

The Upper Pond-bank is said to have a depth of forty-three feet in ore, the ore coming to within ten feet of the surface. From the bottom of the original central shaft they drove a tunnel out to daylight, and used it afterwards for hauling out the ore.

The English diggings, on the back of the Little Mountain, are only a trench, fifty feet wide by one hundred and fifty long, and from five to twenty-five feet deep, cut slanting up the side of the mountain (or hill, as it really is not 200 feet high), and showing a white clay covering, massive, eight feet thick, dipping 20° to the eastward. The ore, which is under it, cannot now be seen, because of the condition of the pit; but a set of fresh trial pits, outside of the main pit, show the ore in good condition within five feet of the soil.

A branch railroad from Scotland Station, up the valley of the

Conecocheague, *seven miles*, to the Caledonia and Pond-banks, and thence forward along the ore belt, *two miles*, to the Home-bank, and *one mile* further to Mont Alto Furnace, making ten miles in all, is about to be constructed. The route follows a wide and shallow meadow valley, with a rise (by barometer) of 20 feet in the first four miles; 90 feet in the next three miles, to the first ore beds; and 230 feet for the next two miles, to the Home-bank opening.

The water of the creek at the furnace is 140 feet below the Home-bank, and 200 feet above railroad grade at Scotland Station (measured by one of Becker & Sons' Aneroid Barometers).

It is within a few hundred feet of one of the Pond-banks that the shaft has been sunk, which penetrated the lignite layers; and it will be noticed, that their horizontality is in agreement, 1st, with the horizontality of all the Silurian measures which sweep round the flat south end of the Little Mountain anticlinal; 2dly, with the horizontality of the ore deposits; and, 3dly, with the general plane surface of the locality. There is no good objection to considering the lignite beds a local deposit of late date, made in a shallow pond, produced either by erosion, or by settling, caused by cavern-solution close underneath, and puddled with the ore-clay so as to hold water and maintain a fresh-water vegetation, with which the forest leaves and trees, incessantly discharged by freshets, would be intermingled. This may have happened at any age after the uplift of the palæozoic system and the subsequent production of the present surface, except so much time as may be represented by the forty feet of sand, &c. lying upon the lignite. There is, therefore, to choose from, the whole interval embraced by the Permian, Jurassic, Cretaceous, and Tertiary areas.

To determine this more nearly, there must first be a determination of the relation existing between the surface of the Palæozoic region and the surface of the Permiano-Jurassic region, commonly separated from each other by the mountain barrier of the Highland-South-Mountain-Blue-Ridge range, but touching each other along the remarkable gap in that range, between the Schuylkill and Susquehanna rivers, and represented on the colored map, plate XI. The present relation of the two surfaces to each other, is shown in Fig. 10, plate X, and a selection from some of their supposed relationships in past times is made in Fig. 11. The so-called New Red Estuary rocks are seen in these sections dipping uniformly northwestward, at angles from 20° to 30°. Their highest stratum, the breccia called Potomac Marble, is sometimes a conglomerate of well-rolled pebbles, in which I have often recognized, not only fragments of the Lower

Silurian limestones and slates of II and III; but quartz pebbles from the Middle Silurian (Llandovery) sandstone of IV, or the not much more distant outcrops of the Upper Devonian and Carboniferous conglomerates of X and XII.

The New Red is seen dipping northward against a country which is lower than its own. The question is not one of a fault to produce this dip: 1. Because a fault which should throw the New Red *down*, must necessarily leave the Silurian dominating it from an elevation; 2. Because the dip exists everywhere, along the estuary for 500 miles, where its northern coast is a mountain anticlinal of Azoic, without trace of fault; 3. Because the north edge of the New Red, at the place of section, is scalloped in such a form as no fault of any magnitude could produce; 4. Because the exposures are good and numerous, and yet there is nothing to show the existence of a fault, upon the ground.

The New Red is seen in the section dipping northward against or toward a country, the surface of which is three hundred feet lower than its own. There is no evidence of a wide extension of New Red over that lower surface in the New Red age. On the contrary, not a hillock or gravel patch of New Red is to be found throughout the whole Palæozoic country to the north or west of this, its present absurdly constructed overhanging and outdipping margin. How is this to be accounted for?

There must have been some barrier to the New Red waters between the Schuylkill and the Susquehanna, to correspond with the barrier which we see everywhere else between the Hudson and the James. Otherwise the New Red waters would have overflowed, by *at least* three hundred feet, the Silurian Valley in its rear, and penetrated to valleys still further back by means of the principal gaps in the Kittatinny Mountains through which the Schuylkill, the Swatara, and the Susquehanna rivers flow. What was this barrier ?

I think none can be suggested but one composed of the *originally much more elevated surface of the Silurian Valley itself.* Carry up the whole mean level of the Palæozoic area—the valley beds up to the present height of the mountains, and the mountain crests to a proportionately greater altitude, the gaps to correspond with both, and the anticlinal and synclinal structure to determine the face of the surface at any given stage of the process,—and we have the required barrier to the estuary of the New Red; the explanation of its top Conglomerate; a good reason why there are no New Red traces

back of the South Mountains; and a closer date for the Lignite of Mont Alto.

In Fig. 11, plate X, where such a reconstruction of an ancient surface of the Great Valley is attempted, there is noticeable, 1. How vast an amount of Palæozoic rock-substance has been swept away; and, yet, that amount represents only the waste of the four lower Palæozoic formations; superposed upon these at a still older date, eight others, including the Coal Measures, must have formed their surfaces; supposing no cataclysm. 2. How fine a chance was given for collecting towards the present surface the ferruginous elements of the slowly decomposing and cavernous-becoming limestone layers; and 3. How the erosion must have acted, for some reason or other, more upon the Palæozoic surface outside, than upon the Palæozoic surface inside the limits of the New Red; the reason probably being, simply, this: that the latter was under the New Red waters, and was being covered up, while the other was being eroded; but the erosion had not yet brought the valley surface down to the New Red water-level, when the uplift of the New Red took place. After which, the two erosions went on with different velocities proportional to the different solubilities, &c., of the Silurian limestone, and of the New Red sandstone, formations.

As for the lignite, therefore, it must have been subsequent to the erosion of the New Red, that is, certainly not older than the Cretaceous lignites of the United States; and when we consider the immense lapse of time needful for carrying the Silurian Valley surface from a level with the tops of the New Red Hills, down to a level with their feet, we may well believe that the precise condition of the ore deposits as we see it, while it commenced before New Red times, was not perfected until the latest tertiary age, and, therefore, this last must be the age of the lignite—apart from all consideration of fossils.

[Captain Geo. B. Wiestling, Superintendent at Mont Alto, writes under date of Jan. 20, 1865, as follows:

"Our pit No. 1, primitive iron ore (Pond-bank), lies at the southwest foot of the 'Little Mountain,' close by the township road leading from Greenwood, on the Baltimore turnpike, to Altodale, near our works. About seven hundred (700) feet south of this pit, we have another larger pit, No. 2. These are about three-fourths of a mile west of a spur (Mont Alto) of the South Mountain. The neighborhood is dotted with a number of ponds, from which it derives its name, 'Pond-bank.' In order to drain the water from and

beneath both these pits, we located and sank a shaft between them and nearer the larger pit. Although our judgment would have dictated a locality a little more eastward, to have struck the bed of ore, yet we selected this as more favorable ground for sinking.

"At a depth of five feet from the surface, we came upon the beautiful white clay which lies immediately upon the ore, and is more or less mixed with it.

"At ten feet from the surface we penetrated through the white clay and met a clear, sharp, light colored sand, which continued for about five feet.

"Then we found yellow clay mixed with sand, and spotted with red clay (pigment). This varied but little until we attained a depth of forty (40) feet from the surface, where, at a distinct, decided line, almost horizontal, dipping, if at all, a little south, we encountered a close-grained, tough, black clay, with small particles, as large as a grain of wheat up to a grain of oats, resembling small pieces of charcoal, intermingled with it. This proved only one foot thick; and then, at a depth of forty-one (41) feet from the surface, we came upon the *lignite*.

"After penetrating this four (4) feet, a layer, one foot thick, of a tough, gray, sandy substance, intervened; after which we met a lower stratum of the lignite, apparently growing more solid as we descended.

"Through this we continued to sink, for eighteen feet further, where about one foot of sand covered a beautiful variegated clay, pearl and white body, with crimson and purple streaks through it. At two feet deeper, the southwest corner of the shaft showed pure red, and the northeast corner pure white clay.

"Thus far, then, we had sunk sixty-seven (67) feet from the surface, and had developed two strata of lignite, respectively four (4) feet and eighteen (18) feet thick.

"This depth (67 feet) was more than necessary for our purposes in sinking the shaft, and we commenced a drift or adit, three feet above the bottom of the shaft, in the lignite, in the direction of the layer, pit No. 2 (south). This drift we have driven, to this date, forty-eight (48) feet in the lignite; but yesterday the ground showed evidences of a change to light-colored clay. We have concluded to return to the shaft, and from its bottom sink a smaller pit still deeper, for purposes of observation; a small contribution to science The results I will advise you of as we progress, with pleasure.

"The lignite, when excavated, was solid, rang and glistened like anthracite. Exposure to the air disintegrated it to a certain extent, and impaired its lustre. It burns freely, with a bright flame and intense heat, and proves excellent for generating steam. It cokes beautifully.

"When drying pieces of it (for experiment) on the stove, a considerable quantity of oil fried out, and the empyreumatic odor was very decided. This circumstance, in connection with the fact of a heavy, greasy coating on our springs and streams (heretofore credited to the iron ore), causes considerable speculation as to the existence of petroleum at no great depth.

"In the field lying between the 'Little Mountain' and South Mountain, east of the English-bank, we have sunk a number of test pits. In all but one, we have found ore near the surface. In this exception, located about two hundred feet east of the English-bank, at a depth of fifteen (15) feet, we encountered a black clay, similar to that which immediately overlaid the lignite at the Pond-bank.

"A number of circumstances combined to prevent our sinking the pit any deeper at the time, though we intend developing what lies beneath, in the early spring."]

Mr. Foulke inquired whether or not any of the members present had collected such evidence in relation to deposits of iron, as would throw new light on the origin of such beds.

Mr. Foulke referred to the discovery of the part which infusoria had taken in the formation of silicious rocks, and remarked upon the contributions of the United States Coast Survey; and said, that the fact of assimilation of iron by minute marine animals, might suggest an analogy with Ehrenberg's microscopic results in the origin of beds of iron.

Mr. Lesley remarked upon the appearance of encrinites in strata of carbonate of iron, as interesting exemplifications of the metamorphosis of encrinitic limestone deposits to iron ore beds among the coal measures.

Mr. Foulke recurred to the distinction between the example of carbonate of iron and that which he had presented, viz.: the formation of ore-beds in a manner analogous with those of Ehrenberg's silicious rocks.

Mr. Osborne, present by invitation, exhibited a port-folio of lithographic plates, and explained his process of copying by Photo-lithography. Mr. Osborne said:

This method of combining photography with lithography is not new; it is a tried and tested process, which for upwards of five years, has been actively employed by the government of the British Colony Victoria, for the production of maps. The invention dates from the 19th of August, 1859, and the first official map was produced by it on the 3d of September following; since which time several thousand different original maps have been photo-lithographed by its means, and sold to the public. The saving, both in time and money, which its introduction has effected, is very great; and the government of the colony has erected, according to my suggestion and plan, a substantial office consisting of several rooms, exclusively for the prosecution of this method of reproduction. In 1861, the Victorian Parliament acknowledged my services, and the estimation in which they held the process, by voting me unanimously the sum of £1000.

The general history of photo-lithography, and the details of the various processes which have been put forward from time to time, is a subject too extended for me to discuss on the present occasion; I shall confine myself therefore, to a description of my own solution of the difficulty, the superiority of which, for certain kinds of work at least, I believe now to be undisputed.

Before proceeding to details it may be well to state, that the process is designed and fitted for the reproduction of existing originals only, such as maps and plans, engravings, pen-and-ink drawings, MS. and printed documents, &c., and not for producing portraits or views directly from nature. The problem to be solved may be defined, more accurately, as follows: From a given original existing as a black and white drawing or engraving, to produce by the chemical agency of light, a fac-simile on stone, identical in character with an ordinary lithographic drawing, which has been fitted for the printer.

The first step in the process is the production of a negative, which shall bear the desired relation to the original in size. This is done by placing the latter upon an upright plan-board, and the camera opposite to it, taking care that the plan-board and the ground-glass slide of the instrument are perfectly parallel, and that the distance between them is such as to give a copy of the desired dimensions. The negative picture is then taken in the ordinary way on collodion, but with numerous precautions, so as to secure the best possible result.

Having proceeded thus far, it is necessary to prepare the sensitive surface upon which the positive print from this negative is to be made. All the processes of which anything was known or published up to my time, were based upon the idea that the surface of the stone should be made sensitive to the action of light, and that the photographic picture formed thereon should possess the necessary and peculiar lithographic properties. I deviated from my predecessors in this respect, and struck out a new course, which at once gave superior results. This consisted in sensitizing a sheet of paper in such a way as to make it fulfil similar conditions; and having produced upon it a photograph in lithographic ink adapted for the purpose, the same is transferred to stone by a well-known lithographic operation, and printed in the ordinary way.

To effect this object, a sheet of paper of the best quality is prepared with a solution of gelatine and bichromate of potash in water, to which a quantity of albumen has been added. This mixture is poured into a long narrow trough, and one side of the paper is covered with it, by drawing a sheet over the fluid in the trough, while an assistant presses it into contact with the same by means of a piece of wood of suitable form.

The paper thus coated is carefully dried in the dark, and upon it a positive print from the negative above mentioned is printed by light in the manner practised by photographers. The result is that a brown picture makes its appearance upon the clear bright yellow of the paper, identical in every respect with the original which was copied, unless perhaps a reduction or enlargement in size may have been decided on. It is not however the change in color which makes this picture valuable for photo-lithographic purposes, but rather the alteration in the chemical and physical properties of the organic substances, which form the superficial coating upon the sensitive paper, the nature of which will be understood when the following operations are described. These are technically known as "blacking," "swimming," and "washing off." Blacking an exposed positive has for its object the distribution of an even coating of lithographic transfer ink over its surface. Such an ink is essentially composed of greasy or resinous substances fused together, and blackened with lampblack. For our present purpose it is distributed with the printing roller over the surface of a stone in the press, and upon it the exposed positive print is laid, with the photographic picture downwards, and in contact with the ink. After passing both stone and paper through the press, and separating them, the latter will be found to have brought away

with it an even coating of the lithographic ink, hiding almost totally the photographic delineation from view. The swimming, or as it is also more properly called, "coagulation," is the next step; it is accomplished by letting the blackened print float upon the surface of boiling water, with its uncoated side downwards. The chief result sought to be secured by this operation is the coagulation of the albumen contained in the film. This takes place, due to the action of the moisture and heat together; and in addition to it another advantage is gained by the percolation of the water through the paper, namely, the softening and gelatinization of the gelatine contained in the coating of organic matter under the ink. This change extends only to such portions of the sensitive surface as were protected from the action of light by the negative; those which form the picture suffer no further alteration while the print is swimming, due to the solvent action of water; they do not soften or swell, and demonstrate this fact by remaining depressed, in relation to the other parts of the blackened surface, which rise very perceptibly around them.

After sufficient soaking, we have to remove from this print the superfluous ink which is upon it, our object being to retain that portion only which goes to form the picture. This is effected by placing the wet sheet upon a smooth surface, and applying a moderate amount of friction to it by means of a wet sponge, or similar substance. Gradually the ink leaves those portions of the blackened print which represent the white parts of the original; but the exposed or positive portions retain it with great tenacity, owing to the chemical alteration which the light has effected in them. Eventually we find ourselves possessed of a copy of the original in lithographic ink, which is washed in abundance of water, and dried.

The ink upon the print, the preparation of which has been just described, is transferred to stone by a process more or less thoroughly understood by ordinary lithographers, occurring as it does not unfrequently in the routine of their business. It consists in laying the print, inverted, upon a clean and smooth lithographic stone, which has been slightly warmed, and passing it through the press. The consequence is, that the greasy lithographic ink passes over to the stone, and forms there a chemical picture which is reversed, and from which, after it has been properly "etched" or "prepared," impressions can be taken in the press.

The coagulated albumen, upon which some stress has been laid, plays an important part during this operation of transferring; for, owing to its insoluble nature, no amount of washing can remove it

from the surface of the paper; and after the print is washed off and dried, the inky picture is found to rest, as it were, upon a sheet of albumenized paper. This is damped slightly before laying it upon the stone, and, when the heavy pressure of the press is brought to bear upon it, the albumen shows an amount of adhesiveness sufficient to make it stick fast, and prevent any shift, or doubling of the lines, until the stone and print have been carried through the press as often as the operator thinks necessary.

The latest application which has been made of this process, is one to which I attach much importance; I refer to the illustration of a Prussian Government work, descriptive of the expedition which that state sent a few years ago to Japan, China, and Siam. I am happy in being able to lay the plates belonging to the first part of this work before the members of your Society. They consist of twelve small views and six large ones, besides two maps, and are reproductions of pen-and-ink drawings, made by the landscape painter, Mr. A. Berg, who was sent with the expedition. Two of the larger plates are printed in colors, in imitation of water-color drawing, a combination of chromo- with photo-lithography, which is here made for the first time. On the worth of a process of this kind, whereby every touch and every feeling which the artist puts into the creations of his genius, is reproduced in permanent printing-ink, or by means of which rare and costly engravings can be given to the public at a nominal cost, I do not require to dilate. Mr. Berg, whose connection with the Japanese work naturally makes him a severe critic, has expressed his opinion to me in a letter which I value very highly, and I feel that I cannot conclude my remarks better than by quoting the portion of his communication which bears upon this subject. He says:

"The President of the Royal Commission, appointed to superintend the publication of the East-Asiatic Travels, has requested me to express to you his grateful acknowledgments of your great services and disinterested exertions in this work. It gives me the greatest pleasure to be enabled to make this communication to you; and I avail myself of the opportunity to express to you also, my own sincere thanks for your assistance in this work. You have solved the most difficult problems in this field,—problems, the solution of which I myself despaired of, until the successful result was placed before my eyes. The question, whether pen-and-ink drawings can be multiplied by photo-lithography, and thus made valuable to the artist, is determined by this work."

Mr. Osborne exhibited a portfolio of reproductions of engravings, pen-and-ink drawings, maps, &c., of great excellence, and some of them of rare beauty, fully justifying, in the opinion of the members present, his views of the merits and utility of the process.

President Smith exhibited a piece of lignite from the Dutch Gap Canal, just excavated by the troops of General Butler, to facilitate the operations carried on against Richmond.

The stated business of the meeting being called for, it was, on motion of Prof. Cresson, resolved, that the subject of the claim signed "Torricelli" was worthy of the Magellanic Premium.

The members were then required by the terms of the Fund to declare whether they had considered the subject, so as to entitle them to vote; whereupon the members so making declaration voted, by ballot. The ballot-boxes were then scrutinized by the presiding officer, who announced that the vote was unanimous, and in favor of bestowing the premium upon the claimant.

The sealed package was then opened by the President, and the name of Mr. Pliny Earle Chase was read.

PHILADELPHIA, October 1, 1864.

DR. GEORGE B. WOOD,

President of the American Philosophical Society.

DEAR SIR: I offer, for a Magellanic Premium, the discovery of certain new relations between the solar- and lunar-diurnal variations of magnetic force and of barometric pressure.

The experiments upon mechanical polarity, which were exhibited to the Philosophical Society at its meeting of April 1, 1864, and the series of communications to the Philosophical and Royal Societies, of which those experiments formed a part, have shown that the simple aërial and aethereal currents which are produced by the combination of solar and lunar action with rotation, are sufficient to polarize the atmosphere, and through its specific magnetism to impart a directive polar energy to a magnetized needle.

Since the principal agency of the sun in producing currents and barometric fluctuations appears to reside in the heat of its rays, and that of the moon in its differential or tidal attraction, it seems very probable that the ratio of the barometric to the magnetic disturbance of each luminary may be some function of the relative barometrical and tidal effects of the two bodies. This hypothesis is confirmed by the fact that the lunar-diurnal variations, both of the magnet and of the barometer, exhibit two high and two low daily tides, while the solar-diurnal magnetic variation, like the temperature-tide of the barometer, has only one maximum and one minimum in twenty-four hours.

Let $A =$ the tidal-current variation of equilibrium.
$B =$ the diurnal barometric variation.
$M =$ the diurnal magnetic variation.

Let the solar elements be distinguished by A', B', M'; the lunar by A'', B'', M''.

If the modern physical hypotheses are correct, and the forces that produce A, B, and M are all forms of motion, it is probable that some simple relationship may exist between them. In endeavoring to ascertain that relationship, we readily discover that

$$A' < A''$$
$$B' < M'$$
$$B' > B''$$
$$B'' > M''$$

These inequalities, together with the fact that the solar currents are developed in air that is disturbed by the greater attractive energy of the moon, and the lunar currents in air that is disturbed by the more powerful barometric action of the sun, suggest the supposition that B may be a mean proportional between A and M, and that we may therefore have the following equivalent proportions:

$$B' : B'' :: \sqrt{A' \ M'} : \sqrt{A'' \ M''}$$
$$A' : A'' :: \quad B'^2 \, M'' : \quad B''^2 \, M'$$
$$M' : M'' :: \quad B'^2 \, A'' : \quad B''^2 \, A'$$

From the same considerations, we may readily infer that

$$\frac{B'}{M'} = \frac{A'}{A''} \qquad (1)$$
$$\frac{B''}{M''} = \frac{B'}{B''} \qquad (2)$$

and that, $\therefore$, B'' is a mean proportional between B' and M''.

According to Maj.-Gen. Sabine's tables (St. Helena Obs., vol. ii, p. lxi), there is a solar maximum, measured in parts of the total force,

of +.00095 at noon, and a solar minimum of—.00045 at 11 P. M.,

$$\therefore \qquad M' = .0014 \qquad (3)$$

The lunar tide is so modified by rotation, that its true value can perhaps be best ascertained by adding the tides at equal distances from the lunar meridian (op. citat., p. lxii), and taking their average.

LUNAR-DIURNAL MAGNETIC VARIATION, IN MILLIONTHS OF THE TOTAL FORCE.

	0 h.	1 h.	2 h.	3 h.	4 h.	5 h.	6 h.	7 h.	8 h.	9 h.	10 h.	11 h.	12 h
Before Lunar M.,	+5	—1	+4	—2	—5	—5	—6	—3	—2	—1	+14	+15	+16
After " "	+5	—1	—5	—6	—7	—6	+1	+1	—2	+18	+25	+22	+16
MEAN TIDE, . .	+5	—1	—.5	—4	—6	—5.5	—2.5	—1	—2	+ 8.5	+19.5	+18.5	+16

We thus obtain an average low tide of —.000006 at 4 h., and a high tide of +.0000195 at 10 h., which gives

$$M'' = .0000255 \qquad (4)$$

The values of B, as deduced from the tables presented at the meeting of July 17, are

$$B' = .016 \text{ in.} \qquad (5)$$
$$B'' = .00365 \text{ in.} \qquad (6)$$

Dividing by 28.2821, the mean height of the barometer, in order to obtain results in terms of the total barometric pressure, we have

$$B' = .00056573 \qquad (7)$$
$$B'' = .0001291 \qquad (8)$$

The relative values of A′ and A″ have never been precisely determined. Probably the latest and most correct estimate is the one given in the New American Cyclopedia, Article "Tides," according to which, if

$$KA' = 1 \qquad (9)$$
$$KA'' = 2.55 \qquad (10)$$

Of the homologous quantities contained in (1) (2), it is fairly presumable that those of the greatest magnitude (B′, M′) have been most precisely estimated. Assuming their accuracy, we have:

1. If (8) be supposed correct,

$$M'' = .00002944 \qquad (11)$$
$$\frac{A'}{A''} = \frac{1}{2.475} \qquad (12)$$

2. If (4) be supposed correct,

$$B'' = .00012 \qquad (13)$$
$$\frac{A'}{A''} = \frac{1}{2.475} \qquad (14)$$

3. If M′ and B″ are required, (4), (9), (10), being supposed correct,

$$M' = .00144 \qquad (15)$$

and the value of B″ is the same as in (13).

Other hypotheses might be made, but these are sufficient for illustration.

Even the widest discrepancy between theory and observation is much less than might have been reasonably anticipated in measurements of such extreme delicacy, and far within the limits of probable error, as will be seen by the following synopsis:

	KA′	KA″	B′	B″	M′	M″
Observed,	1	2.55	.00057	.00013	.0014	.0000255
Theoretical, 1	1	2.475	.00057	.00013	.0014	.0000294
Theoretical, 2	1	2.475	.00057	.00012	.0014	.0000255
Theoretical, 3	1	2.55	.00057	.00012	.00144	.0000255

From the hypothetical formula $B = \sqrt{A\ M}$ we deduce the following values:

	Observ.	Theor. 1.	Theor. 2.	Theor. 3.
K	4374	4374	4374	4499
A′	.000229	.000229	.000229	.000222
A″	.000653	.000566	.000565	.000565

In regard to the first theoretical value of M″, it may be observed that it is very nearly equivalent to the mean between .000032, the extreme excursion of the lunar tide, and .0000255, the mean tide.

"Torricelli."

Mr. Chase made some remarks, in explanation of the subject of the premium.

In the fifth century before the Christian era, Leucippus and his disciple Democritus taught that heat is the soul of the world, the principle of life and intelligence, and that space is an infinite plenum, pervaded by material atoms too minute to be perceptible to the senses, which, by their constant motions, unions, and separations, form the beginnings and ends of things. In this theory, which is said to have been borrowed from the priests of Isis and Osiris, we may trace the origin of the modern belief in a universal kinetic æther, and of the attempts to resolve all forces into "modes of motion," which were practically inaugurated by our own countryman, Benjamin Thompson, Count Rumford, and which have been so successfully prosecuted by Carnot, Seguin, Mayer, Colding, Joule, Grove, and their collaborators.

The mutual convertibility of Light, Heat, Electricity, Magnetism, Chemical Affinity, and Vital Energy, may be now regarded as one of the most probable physical hypotheses. Faraday has endeavored also to connect gravitation and magnetism or electric action by experimental results, but in vain. Still, the conviction of such a connection is almost irresistible, and various physicists have given us incidental pointings in that direction. Ampère discovered the magnetic effect of electric currents circulating around iron bars; Arago, whose experiments were repeated and extended by Babbage, Herschel, Barlow, Christie, and others, showed that simple rotation produces magnetic disturbances which are governed by fixed laws; the distribution of induced magnetism in masses of iron, as determined by Barlow and Lecount, is the same as would follow from the relative centrifugal motions of different portions of the earth, provided the magnetic axis corresponded with the axis of rotation;* Hansteen suspected, and Sabine practically demonstrated, the influence of the sun upon terrestrial magnetism; Secchi ascertained that "the diurnal excursion of the needle is the sum of two distinct excursions, of which the first depends solely on the horary angle, and the second depends, besides, on the sun's declination,"† and that "all the phenomena hitherto known of the diurnal magnetic variations may be explained by supposing that the sun acts upon the earth as a very powerful magnet at a great distance."‡

This hypothesis has been objected to on the ground that it is difficult to understand how any conceivable intensity of solar magnetism, by its simple induction, could produce so great a disturbance as is daily observed. Therefore it will probably follow the fate of the earlier ones, which attributed terrestrial magnetism to one or more powerful magnets lying nearly in the line of the earth's axis, while Barlow's idea that the magnetism is superficial and in some manner induced,§ will still remain in the ascendant. Secchi's conclusions are, however, none the less interesting, and from the fact that magnetism is, like gravity, a central force, varying inversely as the square of the distance, they lend encouragement to those who are endeavoring to find new evidences of the unity of force.

My own experiments and researches have led me to the belief that all magnetism is a simple reaction against a force which disturbs

* This fact was first announced by me, at the Society's meeting, April 15, 1864. See *ante*, p. 367.

† Phil. Mag. [4] 8, 396. ‡ Ibid. 9, 452. § Phil. Trans., 1831.

molecular equilibrium, that the numerical equivalent of the magnetic force is therefore equal and opposite to that of the disturbing force, ($\pm M = \mp D$), and that all the phenomena of terrestrial magnetism result from tidal and thermal changes in terrestrial gravitation.

Sullivan* and Reinsch† have pointed out the effect of musical vibrations upon the magnetic needle, and I have shown the controlling influence of a purely mechanical polarity.‡ A careful examination of the polarizing thermal and rotation currents,§ will show that the spirals, which they have a tendency to produce, are quasi horizontal cyclones, one set flowing in a nearly constant direction along the magnetic meridian, and the other towards the momentarily shifting solar meridian. The communication of "Torricelli" referred to but one or two of the relations under which these eddies may be viewed; there are others, some of which are perhaps even more curious; and, from the examinations which I have already made, I have deduced the following theses:

I. The daily magnetic variations, though subject to great disturbances, at different hours, show an average approximation to the differences of the gravitation-tidal currents.

Hours from Mean, ...	1h.	2h.	3h.
Means of Theoretical Ratios, . .	.500	.866	1.
" " Observed "	.563	.865	1.

II. Marked indications of an accelerating force are discoverable in the magnetic fluctuations, especially during the hours when the sun is above the horizon.

Hours from Mean, ...	1h.	2h.	3h.
Mean Ratios of Hourly Tidal Differences,	100	73	27
" " " Squares of Hourly Magnetic Differences,	100	74	26

See also Thesis V.

III. There are lunar-monthly barometric and magnetic tides, which may be explained by differences of weight or momentum,|| occasioned by the combined influences of solar and lunar attraction, and terrestrial rotation.

IV. The solar-diurnal variations of magnetism between noon and

* See De la Rive's Electricity, v. ii, p. 635. † Phil. Mag. [4], 13, 222.

‡ Ante, p. 359. § Ibid., p. 367 sqq.

|| I believe there can be no weight without some degree of momentum. See Proc. A. P. S., vol. ix, p. 357.

midnight are nearly identical in amount with the variations of weight produced by solar attraction at the same hours.

The ratio of the solar to the terrestrial attraction for any particle at the earth's surface, being directly as the mass, and inversely as the square of the distance ($M \div R^2 = 354{,}936 \div 23{,}000^2$), is .00067. The weight of any particle is therefore increased by this proportionate amount at midnight, and diminished in the same proportion at noon, making a total half-daily variation of .00134 in the atmospheric weight, and consequently, according to my theory, in the terrestrial magnetism.

Theoretical variation, .00134. Observed variation, .00138.

V. The magnetic variations at intermediate hours, between noon and midnight, indicate the influences of an accelerating force, like that of gravity, modified by fluctuations of temperature and by atmospheric or ætherial currents.

Every particle of air may be regarded as a planet revolving about the sun in an orbit that is disturbed by terrestrial attraction and other causes. In consequence of these disturbances, there is an alternate half-daily fall towards the sun, and rise from the sun. By the laws of uniformly accelerated and retarded motions, the mean fall, and the consequent mean magnetic disturbances should occur at $12h. \div \sqrt{2} = 8h.\ 29'$ from midnight.

Theoretical mean, 8h. 29′. Observed mean, 8h. 31′.

VI. Some of the magnetic influences appear to be transmitted instantaneously, through the rapid pulsations of the kinetic æther,—others gradually, through the comparatively sluggish vibrations of the air.

VII. The comparative barometric disturbances of the sun and moon exhibit an approximate mean proportionality between their comparative differential-tidal and magnetic disturbances.

Let the solar differential-tidal force be represented by A', and the lunar by A'', the respective barometric disturbances by B' and B'', and the magnetic disturbances by M' and M''. If M' and B'' are required, we have

	$A' \div A''$	B'	B''	M'	M''
Theoretical values,			.00012	.00144	
Observed "	2.55	.00057	.00013	.00140	.0000255.

VIII. The theoretical gravitation-variation of magnetism (Prop. IV) is slightly less, while the theoretical barometric variation (Prop.

VII) is slightly greater than the corresponding observed variation. The excess in one case exactly counterbalances the deficiency in the other, the sum of the theoretical being precisely equal to the sum of the observed variations.

IX. The total daily magnetic variations, like the barometric, can be resolved into a variety of special tides, which may be severally explained by well-known constant or variable current-producing and weight-disturbing forces.

	A	B	A+B	
Hours from Midnight.	Theoretical Gravitation Tide.	Theoretical Differential Solar Tide.	Theoretical Mean Tide.	Observed Mean Tide.
0	—.00067	+.00024	—.00043	—.00043
6	.00000	—.00024	—.00024	—.00023¼
12	+.00067	+.00024	+.00091	+.00095

The hours are counted from midnight, in each half-day.

Column A contains the hourly differences from mean weight, attributable to solar gravitation, with changed signs; diminution of weight being accompanied with increase of magnetism, and *vice versa*.

The form of the tide in column B is evidently such as should be determined by solar action. The magnitude of the tide is estimated by comparing the relative amounts of motion down the diagonal and down the arc of a quadrant ($.00067 \times [1-(\frac{\pi}{4}-\frac{1}{2})] = .00048$). The mean-tidal difference [$(.00067-.00048) \div 2$] is very nearly equivalent to the average theoretical inertia-disturbance of weight. The atmospheric inertia at St. Helena, (regarding the fluctuations as uniform between successive hourly observations), produces retardations of 59′, 85′, 26′, and 31′, at 0h., 6h., 12h., and 18h., respectively. The mean retardation is 50′, or $\frac{5}{72}$ of a half-day. The theoretical daily gravity-variation being .00134, the average variation in $\frac{5}{72}$ of a half-day is $.00009\frac{11}{36}$, the mean tidal difference being .00009½.

The consideration of the moon's disturbance of the atmospheric gravitation, is complicated by the magnitude of its differential attraction, the position of the centre of gravity of the terrestrial system, the varying centrifugal force, and other circumstances involved in the lunar theory. Still there are indications in the following synopsis, of the influence of gravity, sufficiently striking to encourage a hope that our knowledge of the moon's perturbations may be improved by a thorough comparative study of the lunar a tronomical, atmospheric, and magnetic tables.

LUNAR-DAILY DISTURBANCES OF MAGNETIC FORCE AT ST. HELENA, IN MILLIONTHS OF THE TOTAL FORCE.

Hours.	0	1	2	3	4	5	6	7	8	9	10	11	12
Before Lunar M.	+5	—1	+4	—2	—5	—5	—6	—3	—2	—1	+14	+15	+16
After " "	+5	—1	—5	—6	—7	—6	+1	+1	—2	+18	+25	+22	+16
Mean.	+5	—1	—0.5	—4	—6	—5.5	—2.5	—1	—2	+8.5	+19.5	+18.5	+16
Rotation-Tide.	0	0	$\pm$4.5	$\pm$2	$\pm$1	$\pm$.5	$\mp$3.5	$\mp$2	0	$\mp$9.5	$\mp$5.5	$\mp$3.5	0

The above table shows, that

1. The moon's attractive force ($M \div R^2 = .016 \div 60^2 = .000004$) multiplied by the coefficient of its differential attraction (2.55) gives .0000113, which is nearly the same as the mean meridional magnetic disturbance [$(.000005 + .000016) \div 2 = .0000105$].

2. The increase of magnetism at 12h. is nearly equivalent to the attractive force, multiplied by the square of the distance from the centre of gravity of the system, and divided by the square of the earth's radius ($.000004 \times 7707^2 \div 3963^2 = .0000168$).

3. There is a tendency to equality of disturbances on each side of the meridian at 1h. and 8h., as in the solar magnetic tide.

4. The greatest disturbance occurs at the hours of 10h. and 11h. P.M., both in the solar and in the lunar tide.

5. There are some indications of an increase of gravity and decrease of magnetic force when the tidal flow is towards the centre of gravity of the terrestrial system, and *vice versa*.

6. The rotation-tide has the customary quarter-daily phases of alternate increase and diminution.

X. The phenomena of magnetic storms indicate the existence of controlling laws, analogous to those which regulate the normal fluctuations. See Proceedings Amer. Philos. Soc., Oct. 21, 1864.

The foregoing comparisons have been based on General Sabine's discussions of the St. Helena records. It would be desirable, if it were possible, to confirm them by observations at other stations near the equator, but the need of such confirmation is in great measure obviated by the variety of ways in which I have shown the probable connection of gravity and magnetism. At extra-tropical stations, the rotation tide becomes so preponderating that it is difficult to trace the diminished gravitation- and differental-tides, still I shall look confidently to a fuller development of the theory of tidal action, for future additional support to my views.

Pending nomination No. 529, and new nominations Nos. 530, 531, 532, 533, were read.

The annual report of the Finance Committee was read, and the appropriations for the ensuing year, recommended by the Committee were, on motion, ordered to be made, as follows:

Salary of Librarian, ...	$700 00
Assistant to the Librarian, ...	360 00
Petty expenses of Library, ...	50 00
Janitor, ...	100 00
Binding, ...	150 00
Journals, ...	50 00
Hall account, ...	200 00
Insurance, ...	200 00
Publications (in addition to the interest of Publication Fund), ...	800 00
Commissions to Treasurer and all other incidental charges, ...	590 00
	$3200 00

After which the Society was adjourned.

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